ISSN 0726-9609

THE WESTERN AUSTRALIAN NATURALIST

Vol. 19
No. 2

January 30
1993

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THE WESTERN AUSTRALIAN
NATURALIST

Vol. 19 30th January, 1993 No. 2

IDENTIFICATION OF *PSEUDOMYS CHAPMANI*, *P. HERMANNSBURGENSIS*, *P. DELICATULUS* AND *MUS MUSCULUS* USING FOOTPAD PATTERNS.

By N. K. COOPER
Western Australian Museum, Francis St., Perth, Western Australia 6000

ABSTRACT

Identification of 3 species of native Western Australian rodents (*Pseudomys* spp) and of the feral House Mouse (*Mus musculus*) using footpads is described. Diagrams are provided.

INTRODUCTION

There are approximately 40 small terrestrial mammals in Western Australia. Identification of many of these species is difficult using external characters alone and positive identification can often only be obtained from skull measurements.

A study of the Western Australian Museum collections indicated that the pes (the hind foot) (Figure 1A) of many small mammals have distinctive patterns of pads which can be used to differentiate them. This paper is the first in a series to aid in the field identification of morphologically similar species.

In the Pilbara region there are 3 sympatric species of *Pseudomys* : *Pseudomys chapmani* (Pebblemound Mouse), *P. hermannsburgensis* (Sandy Inland Mouse) and *P. delicatulus* (Delicate Mouse). *P. chapmani* has a distribution ranging from east of the Cape Range in Western Australia through the northernmost part of the Pilbara region and south to the Gascoyne and Murchison districts. This species is usually trapped on or near pebble mounds associated with shallow soils and scree slopes (How, Dell & Cooper 1991).

P. hermannsburgsis has a wide distribution across the whole of the Pilbara, into the Northern Territory and South Australia and south as far as Bungalbin Hill in Western Australia. *P. hermannsburgensis* has been trapped on many substrates including on or near pebble mounds (How, Dell & Cooper 1991).

P. delicatulus occur over the northern parts of Australia; in Western Australia it extends into the northeast part of the Pilbara where it may be trapped adjacent to *P. chapmani* and *P. hermannsburgensis* (How, Dell & Cooper 1991).

Figure 1A: Photograph of the pes of *Pseudomys chapmani* showing the general characteristics.

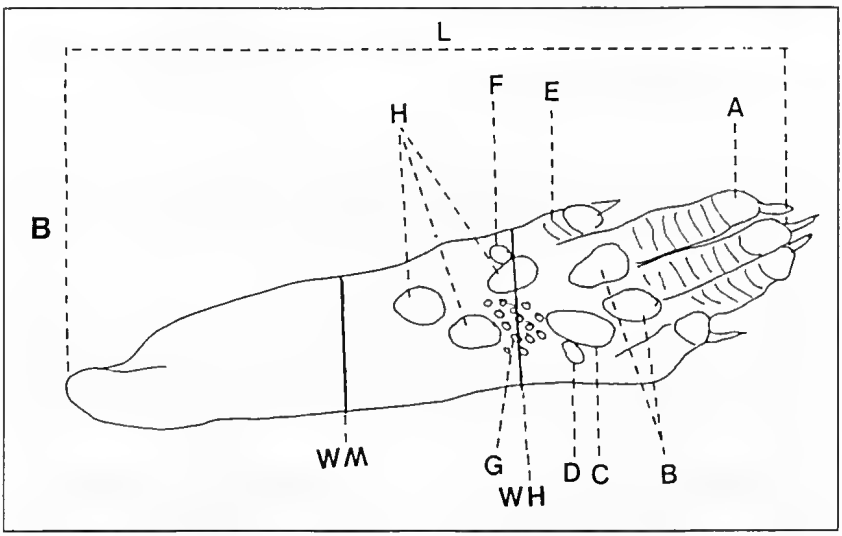

Figure 1B: Diagram of left pes of rodent. (A) Terminal pad; (B) Interdigital pads; (C) Postdigital pad; (D) Postdigital granule; (E) Hallux; (F) Posthallucal granule; (G) Granules; (H) Posthallucal pads; (L) Length of pes from toe tip (excluding nail) to heel; (WH) Width across pes at base of hallux; (WM) Width across pes at midpoint of posthallucal area.

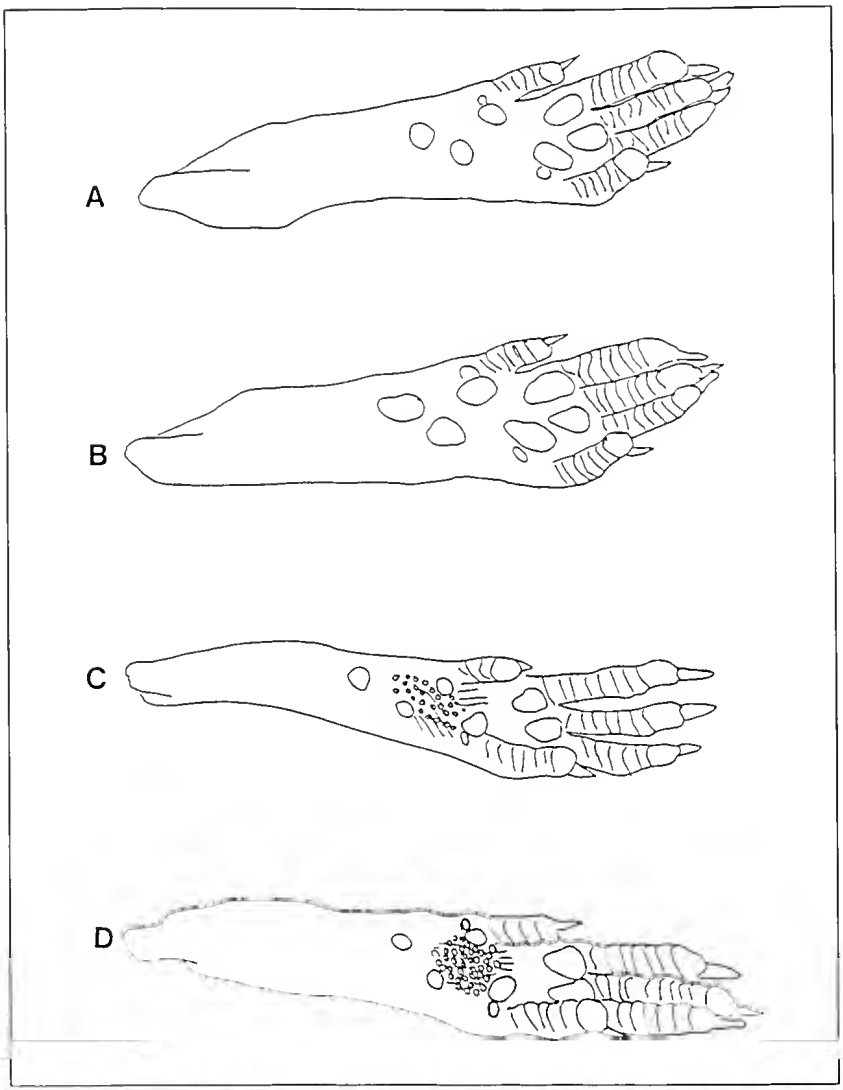

Figure 2: Diagrammatic representations of the pes of (A) *Pseudomys hermannsburgensis*; (B) *P.chapmani*; (C) *P. delicatulus*; (D) *Mus musculus*.

The pelage of these three species is very similar and *Pseudomys chapmani* and *P. hermannsburgensis* are of comparable size. *P. delicatulus* is a much smaller animal than the other two, but adults can easily be confused with the sub-adults of the other species.

Mus musculus is usually identified by the presence of a strong 'mouse' smell and by the notch in the upper incisors. However, *M. musculus* can be confused with *Pseudomys* when smell or notches are absent.

Measurements of the length of the pes and of the width of the pes at both the position of the hallux and at the midpoint of the posthallucal area (Figure 1B) were made of males, females, adults and sub-adults of all four species to determine whether the species could be distinguished by pes size alone (Table 1). However, because of the small difference in actual measurements, the overlap in size ranges, and difficulty in accurately measuring pes of live animals, this method of differentiation between species was found to be inadequate. Kitchener, Adams & Baverstock (1984) used the measurement of pes length versus ear length as a means of distinguishing species of *Pseudomys*. However, this method, though valuable for identifying dead specimens, is inadequate for live specimens.

Table 1: Sample size, mean and standard deviation of pes measurements (mm).

Species	N	Pes length	Pes width (hallux)	Pes width (midpoint)
P. hermannsburgensis	33	16.56+0.80	2.77+0.24	2.25+0.16
P. chapmani	14	16.07+0.77	3.06+0.17	2.53+0.11
P. delicatulus	15	15.75+0.74	2.48+0.20	1.11+0.16
Mus musculus	23	16.19+0.40	3.17+0.32	2.56+0.20

DESCRIPTION OF PES PATTERNS

Figure 2 shows that the main difference between the pes of *Mus musculus* and most species of *Pseudomys*, other than *P. delicatulus*, is the presence of granules and hairs between and around the posthallucal pads in the former. M. *musculus* also has very distinct postdigital and posthallucal granules, these granules are indistinct or often not visible in species of *Pseudomys*.

Pseudomys delicatulus is unlike the two other species of Pseudomys in that it has granules and hairs between and around the posthallucal pads, similar to *Mus musculus*, however, the hairs are longer and more obvious in *P. delicatulus* than in M. *musculus*. A further distinguishing feature between these two species is that the postdigital and posthallucal granules are indistinct in *P. delicatulus*.

Pseudomys hermannsburgensis and *P. chapmani* can be differentiated by the size of the posthallucal pads. In *P. chapmani* these 3 pads are almost equal in size and are slightly larger than the terminal pads. In *P. hermannsburgensis* the 3 posthallucal pads are almost equal in size but are about half the size of the terminal pads.

It is recommended that a 10x hand lens is used when identifying *Pseudomys* spp. from footpads as the pads are difficult to distinguish with the naked eye.

ACKNOWLEDGEMENTS

I would like to thank J.Dell, R.A.How, D.J.Kitchener and K.Aplin for encouragement and advice.

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CONSETT DAVIS: SCIENTIST, SOLDIER, KIMBERLEY COLLECTOR AND CASUALTY OF WAR

By KEVIN F. KENNEALLY, Western Australian Herbarium, Department of Conservation and Land Management, P.O. Box 104, Como, Western Australia 6152

ABSTRACT

This paper documents the contribution to science of Dr Harrold Fosbery Consett Davis with particular reference to his collecting activities in the Kimberley of Western Australia during 1943.

Consett Davis had an outstanding academic record and appeared destined for great things. In 1943 he contemplated applying for the chair of biology at the University of Western Australia. Although effectively in a "reserved occupation", Consett Davis enlisted and was posted to an army guerilla unit operating in the Kimberley in 1943. His role was to identify edible plants and he used the opportunity to make scientific collections of both plants and animals. Although determined to see active service, Consett Davis' military career was curtailed when he was persuaded to go to New Guinea as a biologist with the Tropical Scientific Service to study the disease, scrub typhus. On 11 November 1944, at the age of 31, he was killed in a plane crash in New Guinea.

During the identification of plants from the Walcott Inlet survey in the remote north west Kimberley (see Kenneally & Edinger-this publication) a number of specimens from this locality were found in the Western Australian Herbarium with handwritten labels dated 1943 and signed "CD" (Fig. 1). On the herbarium sheet label the collector was given as "Consett Davis". Who was Consett Davis and what was he doing in the Walcott Inlet area in 1943 - a time during World War Two when the Japanese had bombed Derby and Broome, and most civilians and Aboriginal communities had been evacuated from remote Kimberley areas, for security reasons.

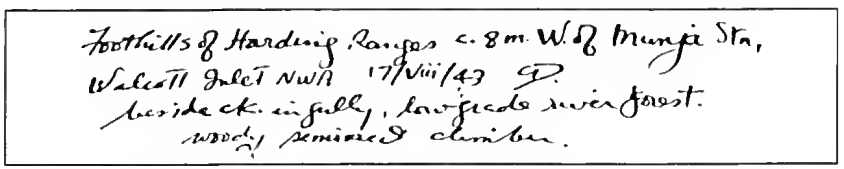


Figure 1. An example of a handwritten label (slightly reduced) of Consett Davis accompanying a specimen of *Opilia amentacea* Roxb. (Opiliaceae) in the Western Australian Herbarium (PERTH). The label reads "Foothills of Harding Ranges c. 8 m W. of Munja Stn, Walcott Inlet NWA 17/viii/43 CD. beside ck. in gully, lowgrade river forest. woody semierect climber.

So began a search of the Western Australian Herbarium records and archives to discover the background to an outstanding biologist whose scientific career was cut short by his untimely death, in 1944, aged 31, whilst on military service in New Guinea.

Figure 2. H.F. Consett Davis photographed "somewhere in N.W.Australia" whilst serving with the Guerilla Warfare Group in the Kimberley.

Harrold Fosbery Consett Davis (Fig. 2) was born in Sydney on 23rd June 1913 and was educated at The King's School, Parramatta, and then attended the University of Sydney. His academic performance was outstanding, and he graduated with First Class Honours in Zoology (entomology) in 1934 and First Class Honours in Botany (plant ecology) in 1935. In 1937 he was awarded a Master of Science to be followed in 1943 by a Doctor of Science degree (both in zoology).

During 1937-39 he was Linnean-Macleay Fellow in Zoology of the Linnean Society of New South Wales, conducting research in plant ecology at the same time. During the latter part of 1938 and early 1939, with leave-of-absence, he travelled to the U.S.A., England and France where he visited various universities and museums. In 1939 he was appointed foundation lecturer in biology at what was then New England University College, Armidale, subsequently the University of New England. During this period he published papers in various journals, of which 34 were entomological and five were on plant ecology.

In 1934 Consett Davis joined the Citizen Air Force and, in due course, graduated and was commissioned as a pilot officer. He was then placed on the Air Force Reserve.

At the outbreak of war in 1939 he was already on the staff of the New England University College and, therefore, in a "reserved occupation". Although he could not be called-up, he insisted on enlisting in the RAAF in September 1940. This caused great embarrassment on all sides and, after two months at Richmond Air Base, where he spent his time teaching himself Japanese, he was discharged on the grounds that as he had not flown for several years he needed a refresher course, which was not available.

Consett Davis returned to academic life in anything but a chastened frame of mind! In November 1941, he enlisted again, this time in the Australian Imperial Force (AIF) and, to ensure that history did not repeat itself, gave his occupation as "labourer". Although the University could have had him discharged at any time, they wisely decided to let him "play soldiers" to get the military out of his system while at the same time ensuring that his attempts to get overseas in a combat unit would be frustrated. Thus, from a mechanised Cavalry Squadron, he was sent as an instructor in tactics to the Armoured Fighting Vehicles School at Puckapunyal, Victoria, then to the 2/7 Australian Division Cavalry Regiment and the Guerilla Warfare Group.

By 1943 concern was mounting over the possibility of a Japanese invasion of the Australian mainland. It occurred belatedly to some of those responsible for defence that , if the Japanese came at all, they might not "knock on the front door", but land undetected on some unguarded and thinly populated shore. A lot of possibilities existed, but the Kimberley area was thought to be particularly vulnerable when it was realised that the only reliable charts and maps of the area were made by the Japanese under the guise of pearling activities over many years. Not only that, but they had omitted the courtesy of providing Canberra with copies. So, after the usual delay for "high level discussions", the 3rd Australian Corps, Guerrilla Warfare Group was formed in 1943, and Consett Davis transferred to this from a Mechanised Cavalry Squadron. The idea was that this group should remedy all defence omissions of the past and, at the same time, live off the land. Consett Davis' botanical knowledge was supposed to enable him to identify edible plants. According to his wife Gwenda Davis: "No one was poisoned. Perhaps they wisely avoided a vegetarian diet."

The Guerilla Warfare Unit was posted to the Kimberley, arriving first in Perth where Consett Davis visited Charles Gardner, the Western Australian Government Botanist. Travelling north by road, Consett Davis began

collecting specimens. As well as plants, he collected shells and insects which went to the Australian Museum, Sydney. The plants he sent to New England University were destroyed by fire in 1958. From the herbarium labels and archival correspondence held at the Western Australian Herbarium it can be ascertained that he was on the Pardoo - Wallal road (behind the Eighty Mile Beach) on 27 May 1943, at Fossil Downs Station 20 June 1943, Lower Liveringa on Fitzroy River on 26 June 1943, Yulleroo Well on Broome - Derby road on 29 June 1943, Munja Station, Walcott Inlet on 17 August 1943 and the Isdell River on 26 August 1943.

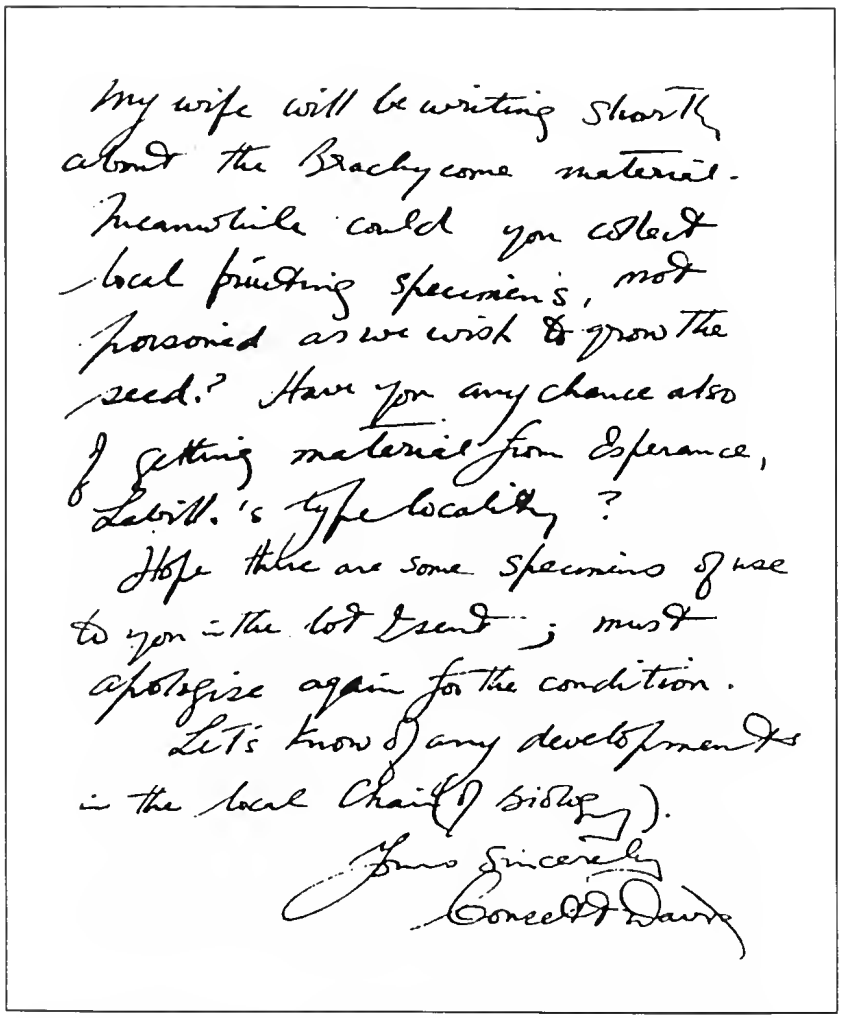

My wife will be writing shortly
about the Brachycome material.
Meanwhile could you collect
local fruiting specimens, not
poisoned as we wish to grow the
seed? Have you any chance also
of getting material from Esperance,
Labill.'s type locality?
Hope there are some specimens of use
to you in the lot I sent; must
apologise again for the condition.
Let's know of any developments
in the local Chair (of Biology).
Yours sincerely
Consett Davis

Figure 3. Sample of Consett Davis' handwriting and signature from his letter to C.A. Gardner dated 27th October 1943.

On 27 October 1943 Consett Davis despatched two parcels of Kimberley specimens to Charles Gardner. An accompanying letter (Fig. 3) told Gardner: "keep whatever you want". The letter also alluded to the taxonomic research on *Brachycome* (Asteraceae) jointly being undertaken with his wife Gwenda and his own interest in applying for the Chair of Biology at the University of Western Australia. Gwenda Davis has confirmed that her husband: "was interested in applying for the Chair of Biology and had left a rough application with me, to be expanded and submitted on his behalf should the occasion arise when he was not able to do so himself".

"as from

New England University College
Armidale N.S.W

27/x/43

Dear Mr Gardner

My wife has sent off by registered fragile post the two boxes of specimens constituting all I collected (reg. nos. 4003-4004). When you have time to examine them, keep whatever you want, return what you can (identified if possible), and, where keeping all of a lot, return at any rate the label plus name.

There are nearly 250 lots or single specimens, some very fragmentary through rigours of field conditions, some broken by lack of proper presses plus the extra dry climate, some damaged in transit. I find that Dr. Rodway has retained no material. His determinations (in pencil on the labels) are only very rough, on first examination from Bentham's Flora. I included them on the slips for purposes of checking your corrected identifications with my written notes on food plants etc., where Dr. Rodway's names are used.

I enclose a fragment from Fossil Downs, Margaret R. [River]; the natives use this as Tobacco. It looks like *Isotoma fluviatilis*.

Hope you can get help from station or mission people, now I've come away, to collect more stuff; if requiring names of possible collectors write to me. Bill Macdonald of Fossil Downs is a good bet. If Harold Reid of Munja doesn't come across with the giant *Blechnum*, try his stockman, Fred Spinks, same address - he'd get it for you himself for a bottle of plonk.

The field notes and crate arrived safely.

My wife will be writing shortly about the *Brachycome* material. Meanwhile could you collect local fruiting specimens, not poisoned

as we wish to grow the seed? Have you any chance also of getting material from Esperance, Labill's [Labillardiere's] type locality?

Hope there are some specimens of use to you in the lot I sent; must apologise again for the condition.

Let's know of any developments in the local Chair (of Biology).

Yours sincerely

Consett Davis"

Charles Gardner replied to Consett Davis's letter on 12 November and acknowledged receipt of the specimens.

"12th. November, 1943.

Consett Davis Esq.,

New England University College

ARMIDALE. New South Wales.

Dear Mr. Davis,

I returned from the country yesterday to find your letter of the 27th. October, and the two parcels of specimens from the North. I am looking forward to delving into these very shortly as time permits, but with the work of the Flora on my hands, the progress must necessarily be rather slow, - depending on the condition of the specimens. The enclosed leaves, much broken in transit, which were enclosed in your letter, may be *Isotoma fluviatilis*, which is not recorded from Western Australia, and I do not think that I can do anything with this damaged fragment. Your other specimens are in quite good order, but will require very careful working through because of the paucity of the flowering material in some cases.

I will return duplicates of practically everything, together with your labels as you request.

Yesterday I received a letter from Dr. Rodway, and in replying I told him that I had not heard from you. Your letter turned up later on.

I shall be on the look out for *Brachycome* seeds for you, and I collected what appear to be two species on the south coast recently. I shall send these shortly.

Regarding your last paragraph, I shall not fail to keep you informed of any developments in the local Biology Department of the University. I understand that the present holder of the position is to remain until the end of the war.

Yours sincerely,

(C.A. Gardner)
GOVERNMENT BOTANIST

P.S. Will send determinations from time to time."

The letter referred to from Dr F.A. Rodway was written on the 30 October 1943. Dr Rodway was Consett-Davis' father-in-law and son of Leonard Rodway (1853-1936), a Tasmanian dentist and honorary Government Botanist. The letter indicates that Rodway was also sent specimens by Consett Davis (but Consett Davis indicates in his letter of 27 October 1943 "I find that Dr Rodway has retained no material").

"THE CORNER,
NOWRA

30 Oct/43

Dear Mr Gardner

My daughter tells me that her husband - Consett Davis has called on you, & that you told him you have specimens gathered by me in the Herbarium.

These would be some I collected when medical officer at Mt Malcolm, nearly 40 years ago.

Sad, is it not, how the years fly by & one gets old and decrepit?

In your *Enumeratio*, there is a *Gunniopsis* (G. *Rodwayi*) listed on p. 42. This would have been sent to my late father, Leonard Rodway of Hobart, and he apparently referred it to Ewart.

I have quite a number of W.A. plants in my Herbarium, mostly from Monlinup, East of Albany, that were sent me by my other daughter when living there, ten years ago.

Consett has also sent me some from "somewhere up North".

I am looking forward to seeing your new Flora of W.A. This will be a valuable work, as it will complete the series of State Floras.

Yrs sincerely

F.A. Rodway"

Gardner replied to Rodway's letter on 12 November 1943.

"12th. November, 1943

Dr. F.A. Rodway,
The Corner,
NOWRA, N.S.WALES

Dear Dr. Rodway,

I was delighted to receive your letter of the 30th. October, and to hear from Mr. Consett Davis that you still take a keen interest in botany. Your name is most familiar to me from the excellent collections in the Herbarium of the Royal Botanic Gardens at Kew. I am afraid that we have very few of your specimens in this herbarium, probably because there was no herbarium here when you were collecting at Coolgardie and Malcolm. *Gunniopsis rodwayi* (Ewart) C.A. Gardn. was collected at Malcolm.

I am nearing completion of volume I of the Flora. I expect that there will be eight volumes altogether. Volume I deals with the families Cycadaceae to Amarantaceae (*sic.*), the Monocotyledons are being left until the completion of the Dicotyledons, for obvious reasons.

I have received from Mrs. Consett Davis, two large parcels of specimens from Kimberley. The diagnoses will take some considerable time, but I will send along determinations and duplicates from time to time. I have received no letter yet from Mrs. Davis.

Yours sincerely,

(C.A. Gardner)
GOVERNMENT BOTANIST"

On the 4th September 1944 Gardner wrote to Consett Davis to advise him that he had made little progress in identifying his plant collections from the Kimberley.

"4th. September, 1944

Mr. Consett Davis,
143 Mossman Street,
ARMIDALE,
NEW SOUTH WALES.

Dear Mr. Davis,

You must be wondering how I am getting on with your material from Kimberley. Just as I was about to commence on the parcels, I was sent up to Kimberley myself, and made a very large collection along the Fitzroy and Ord Rivers. More than half of this has now been determined, and I hope before long to get yours finished. I am kept so busy, however, that you will have to wait for some time yet.

In passing through some of the stations I heard of your visits there, especially from Liveringa, where it was said that you had collected more than one species of *Nymphaea*.

Mrs. Davis has written two letters asking for material of *Brachycome*. During my absence in the north, specimens were sent of a species from near Esperance, but I understand that the one you require was not represented. Esperance is, as you know, a long way from Perth, but an opportunity might occur next month of getting further specimens to the west of Esperance, and I will look out for any *Brachycome* I come across.

Yours sincerely,

C. A. Gardner
GOVERNMENT BOTANIST"

The Guerilla Warfare group did not last for long as it became apparent to the authorities that their task was impossible. At the end of 1943, it was dissolved and became the 43rd Water Transport Operating Company, Landing Craft (Royal Australian Engineers), and, all personnel returned to the east. Consett Davis was posted to an Officer Cadet Training Unit in South Australia, from which he emerged as a lieutenant. There was,

however, still no immediate prospect of an overseas posting and Consett Davis was becoming increasingly disgusted.

Consett Davis now was coming under heavy pressure to leave the AIF and join the Tropical Scientific Service as a biologist. This, he refused to do but, after further and heavier pressure, a compromise was reached whereby he was discharged as NX73645 and re-enlisted as NX203938 with continuity of service and the rank of lieutenant. He was seconded to the Scientific Liaison Bureau, while remaining on the Active List as an AIF officer.

He left for New Guinea in July 1944 and immediately became involved in pioneer work on scrub typhus, which was causing serious casualties among both army and airforce personnel stationed there. In the course of this work, he visited many areas and on one such trip on 11 November 1944, the aircraft failed to clear a nearby mountain on take-off and all on board were killed. He is buried in the military cemetery at Lae. He was survived by his wife Gwenda, two daughters and one son. According to his wife "He did wonder about the origin of the name "Walcott Inlet", because his great-great-grandfather was the eighteenth century naturalist John Walcott". However, there is no connection as the name commemorates Pemberton Walcott, a collector of natural history specimens and inspector of pearl fisheries at Broome.

ACKNOWLEDGEMENT

I wish to sincerely thank Dr Gwenda L. Davis for her enormous support and patience in supplying detailed information on her late husband's career and for the photograph that accompanies the paper.

A BOTANICAL SURVEY OF WALCOTT INLET, KIMBERLEY, WESTERN AUSTRALIA

by KEVIN F. KENNEALLY and DAPHNE CHOULES EDINGER,
Western Australian Herbarium, Department of Conservation and Land Management, P.O. Box 104, Como, Western Australia.

ABSTRACT

A preliminary botanical survey of the Walcott Inlet area, north west Kimberley was undertaken in May 1983 and further visits were made in June 1987 and June 1988 associated with the National Rainforest Conservation Program. The vegetation is described and an annotated list of 344 species is presented. Previous studies of the biological and physical environment are reviewed. Conservation status and botanical significance of the vegetation types are discussed.

INTRODUCTION

A botanical survey of Walcott Inlet, a remote, inaccessible and poorly documented area of the north west Kimberley Division of Western Australia was undertaken in May 1983 during the "dry" season, supplemented with collections made during the National Rainforest Conservation Program surveys in June 1987 and 1988 (McKenzie et al. 1991). Descriptions of the vegetation and an annotated list of species supported by voucher collections are presented in this paper. A complete set of voucher specimens is lodged with the Western Australian Herbarium (PERTH). Duplicate specimens have been distributed to other herbaria.

LOCALITY

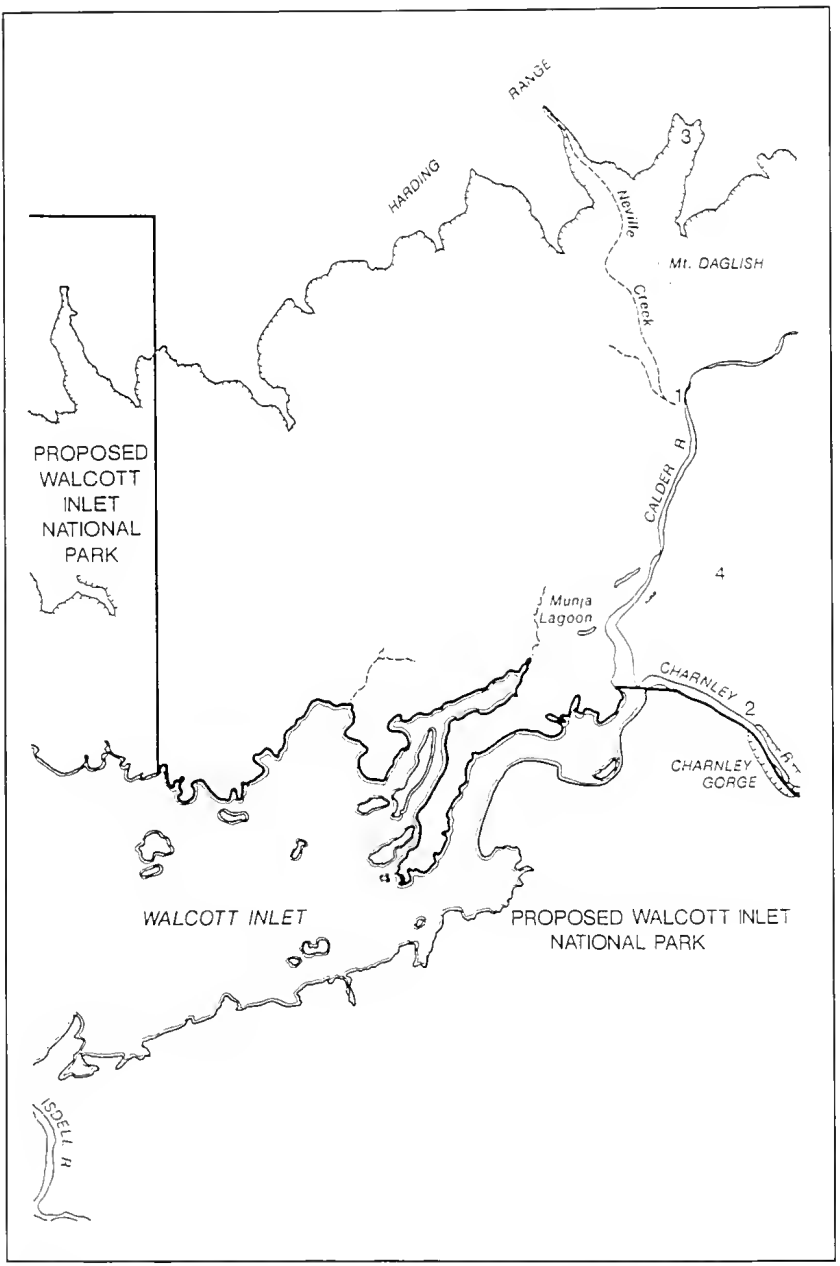
Walcott Inlet, 150 kilometres north-east of Derby, extends eastward from Collier Bay for about 30 kilometres and is up to 11 kilometres wide (Map 1).

The study area includes the eastern surrounds of Walcott Inlet and the Charnley and Calder Rivers. The majority of collecting sites for the expedition were concentrated between the campsite area at the junction of Neville Creek and the Calder River and the ruins of the old Munja mission, 6 km to the south (Fig.1). The remainder of the area is reported from limited observations and brief visits of one or two days during rainforest surveys.

HISTORY

Walcott Inlet is believed to have been named after Pemberton Walcott, by surveyor F.S. Brockman in July 1901 based on his knowledge that T.C. Sholl had given this name to a river in this vicinity (possibly the Calder River) in 1865. Walcott (1834-1883) was a collector of natural history and botanical specimens and inspector of pearl fisheries based at Broome.

The first major examination of the flora in the study area was made by W.V. Fitzgerald during Charles Crossland's 1905 trigonometrical survey. This



Map 1. Eastern end of Walcott Inlet. Numbers indicate fauna study sites.

survey examined the lower reaches of the Calder River and extended west to Mount Daglish and south to the Charnley and Isdell Rivers. Fitzgerald's account of the flora resulted from the first major botanical overland expedition to the Kimberley (Fitzgerald 1907, 1919). A number of Acacia specimens collected by Fitzgerald were described by J.H. Maiden (1917).

The first homestead in this vicinity was established in 1924 the lessees being F.S. & W. R. Easton. The government of Western Australia purchased these leases and along with the remaining Crown land extending to the ocean, established an Aboriginal Reserve (No. 19563) and cattle station at Munja in 1927. By the late 1940's the government became deeply embarrassed by reports of irregularities and exploitation at Munja. As a result it was decided to close down Munja as soon as possible. It was offered to the Presbyterian Church, whose mission work amongst the Aborigines was held in high respect. The formal 'take over' took place on 31 March 1949. A muster of the Munja stock accounted for 1400 head of cattle, 200 donkeys, 300 goats and 40 horses (McKenzie 1969). In 1951 the missions at Kunmunya and Munja were moved to Wotjulum on the mainland opposite Cockatoo Island. Reserve No. 19563 was cancelled in 1958.

A number of specimens were collected from the study area by Consett Davis in August 1943. This collector is discussed elsewhere (Kenneally - this publication).

The CSIRO Land Research Series report prepared from photo-interpretation and from field work in 1954 (Speck *et al.* 1960) represented a new phase of botanical exploration for the area. However their ground traverses did not cover the study area.

CURRENT STATUS

At present, the entire inlet is surrounded by vacant Crown land except at its eastern end, where Pantijan Station is leased by the Federal Government on behalf of the Aborigines of the Mowanjum community, and the land between the Isdell and Charnley Rivers (eastwards to 125° 00' latitude), which is a pastoral lease.

GEOMORPHOLOGY

Walcott Inlet is the broad, shallowly drowned valley of a river (ria) which, in a previous era, followed a structural joint between the Carson Volcanic and King Leopold Sandstone strata. Thus there are contrasting landforms on either side of the inlet.

To the north and north-east, there are undulating lowlands, with dendritic drainage off the gentle slopes of the isolated hills and ridges which is typical of volcanic country. These lowlands are overlooked by a sheer escarpment, the southern margin of a Warton Sandstone plateau stretching northward towards Doubtful Bay.

To the south of the Inlet are rugged, boulder-strewn valleys and ranges typical of King Leopold Sandstone.

Tidal mudflats, up to five kilometres wide, fringe the central and eastern parts of the inlet and are variably inundated by the tides, which have an average effective rise and fall of 11 metres (Fig.2). Around the landward edge of the mudflat there are extensive alluvial plains, including dark alluvial soils, occasional large fresh water lagoons and, where small streams flow out of the sandstone, small swampy areas of deep, sandy soil stained by organics.

Figure 1. Members of the ANZSES expedition at the ruins of the old Munja mission: Andrew Chapman, Bill Clough, Maggie Gibson, Phil Murray, David Fell and Warren Lloyd.

Figure 2. Boat stranded during the emptying of Walcott Inlet at extremely low tide.

Rocky slopes rise steeply from the mangroves and rocky shores at the mouth of Walcott Inlet, terminating in a plateau which in places is bordered by cliffs. Here, the Warton and Pentecost Sandstones overlie the Carson Volcanics and produce a similar topography to that of King Leopold Sandstone. King Leopold Sandstone also forms the Artesian Range between the Isdell and Charnley Rivers, east of Walcott Inlet. Dark grey Hart Dolerite intrudes all these rock types and produces a characteristic black band on many hillsides where scree slopes have been produced by weathering. The sandstones, in particular, yield an angular, blocky scree when weathered, providing excellent shelter for many small animals.

Watered by the Charnley, Calder, Isdell and Sale Rivers, these structurally controlled landscapes have a colourful and rugged grandeur (Fig.3). The Isdell River flows south-westerly from its headwaters then, deflected by the King Leopold Ranges, turns north-westerly to flow into Walcott Inlet. Spectacular gorges, found where the rivers cut through sandstone ridges, are particularly common on the northern margin of the area particularly along the Sale River.

VEGETATION AND FLORA

The plant communities on the dominant surface types have not been surveyed, though observations made during aerial reconnaissance indicate a rich flora. However detailed data are available from some localities.

Extensive tidal embayments and alluvial flats support dense stands of mangroves. Alluvial plains support extensive grasslands dominated by *Eucalyptus tectifica, Eucalyptus greeniana, E. confertiflora, Terminalia canescens, Gardenia megasperma, Erythrophleum chlorostachys* with the occasional boab (*Adansonia gregorii*) (Fig.4). The ground layer is dominated by spear grass (*Heteropogon contortus*) and plains wanderrie grass (*Eriachne festucacea*) (Fig.5).

Alluvial banks adjacent to rivers support *Eucalyptus clavigera, Glochidion sumatranum, Lysiphyllum cunninghamii*, white cedar (*Melia azederach*), *Omolanthus novo-guineensis, Terminalia bursarina* and *Brachychiton diversifolius* and the climbers *Luffa cylindrica, Merremia gemella and M. umbellata* (Fig.6).

Gallery forests extend along the banks of creeks and adjacent to the outcropping sandstone (Fig.7). These permanently damp areas support the tree species *Melaleuca leucadendra, Eucalyptus houseana, Terminalia ferdinandiana, T. platyphylla, Cordia dichotoma, Ficus coronulata, Nauclea orientalis, Syzygium eucalyptoides, S. nervosum, S. operculatum, S. suborbiculare, Thespesia thespesioides, Timonius timon* and *Carallia brachiata.* Dense groves of *Pandanus spiralis* occur with fern beds dominated by mangrove fern (*Acrostichum speciosum*), climbing swamp fern (*Stenochlaena palustris*), *Cyclosorus interruptus*, the rarely collected *Helminthostachys zeylanica* and the aquatic fern (*Ceratophyllum demersum*). (Figs 9 & 10). A large number of herbaceous species occur on the swampy fringes and include *Adenostemma lavenia, Bidens bipinnata, Blumea axillaris, Byblis liniflora, Canscora diffusa, Cressa cretica, Drosera indica, Limnophila fragrans, Marsilea*

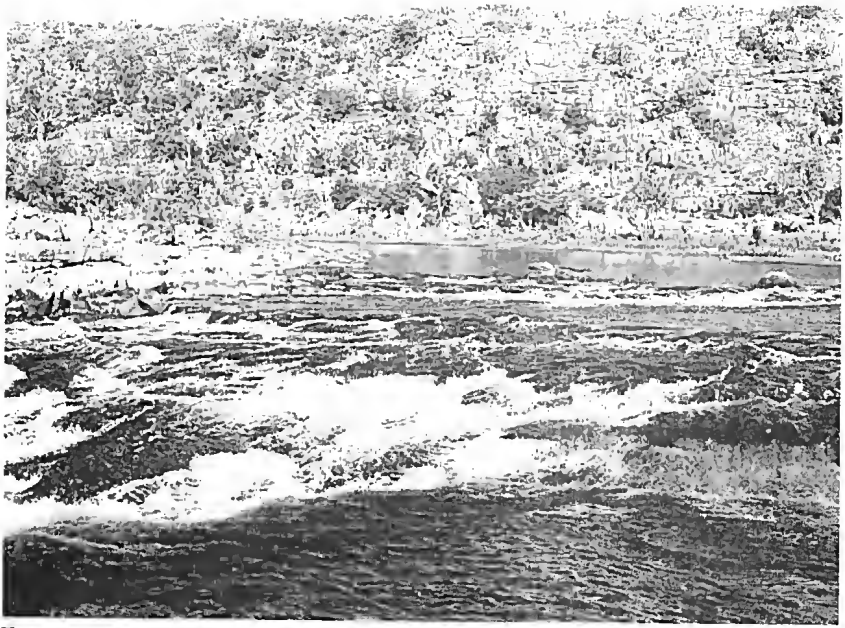


Figure 3. Mouth of the Calder River at eastern end of Walcott Inlet, surrounded by sandstone cliffs.

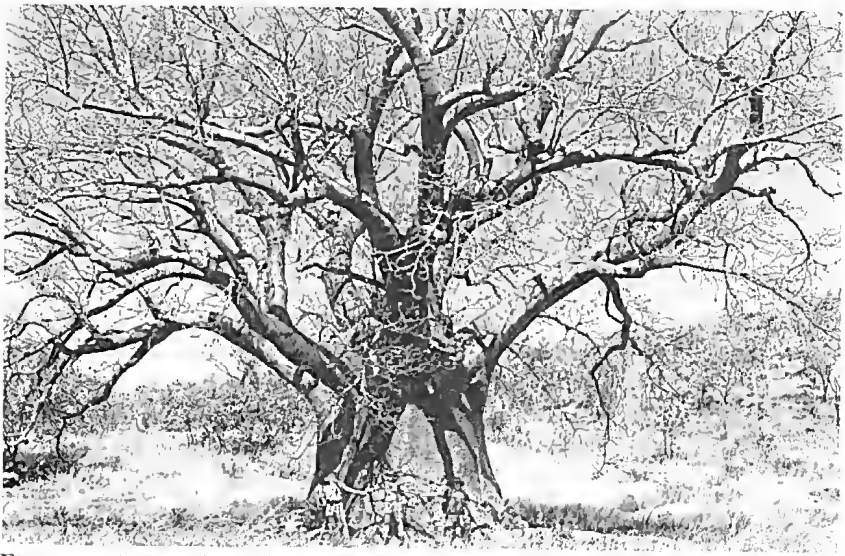


Figure 4. A giant boab (*Adansonia gregorii*) on alluvial plain near old Munja mission.

hirsuta, *M. mutica*, *Mitrasacme hispida* and *Vernonia cinerea*.

Patches of rainforest occur on the steep slopes below the sandstone escarpments, in narrow gorges, in hollows on the upper slopes of some hills and in swampy areas behind tidal mudflats often merging with gallery

Figure 5. Savanna woodland dominates the alluvial plains with Mount Daglish in the background.

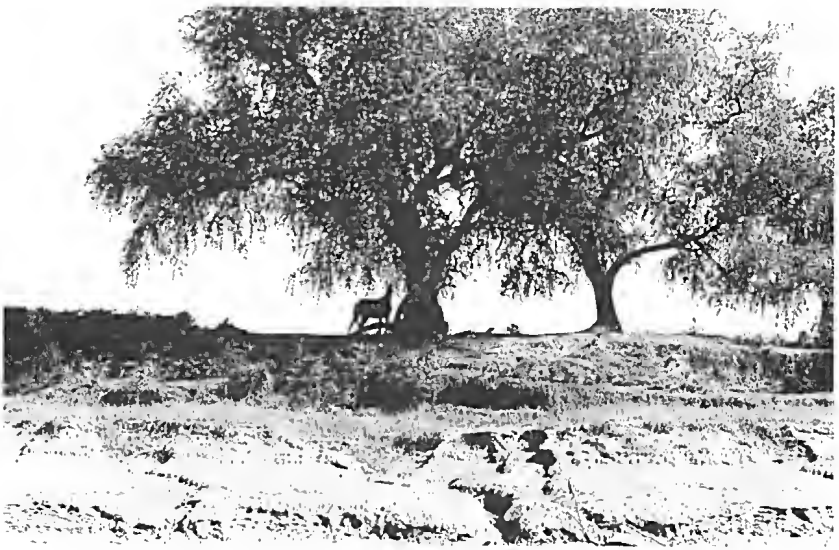


Figure 6. Alluvial banks support groves of bauhinia (*Lysiphyllum cunninghamii*).

forests. Rainforest species include the trees *Aidia racemosa*, *Aglaia elaeagnoidea*, *Albizia lebbeck*, *Alstonia linearis*, *Alphitonia excelsa*, *Bombax ceiba*, *Canarium australianum*, *Celtis philippensis*, *Cryptocarya cunninghamii*, *Ficus virens*, *F. racemosa*, *Ganophyllum falcatum*, *Grewia breviflora*, *Gyrocarpus*

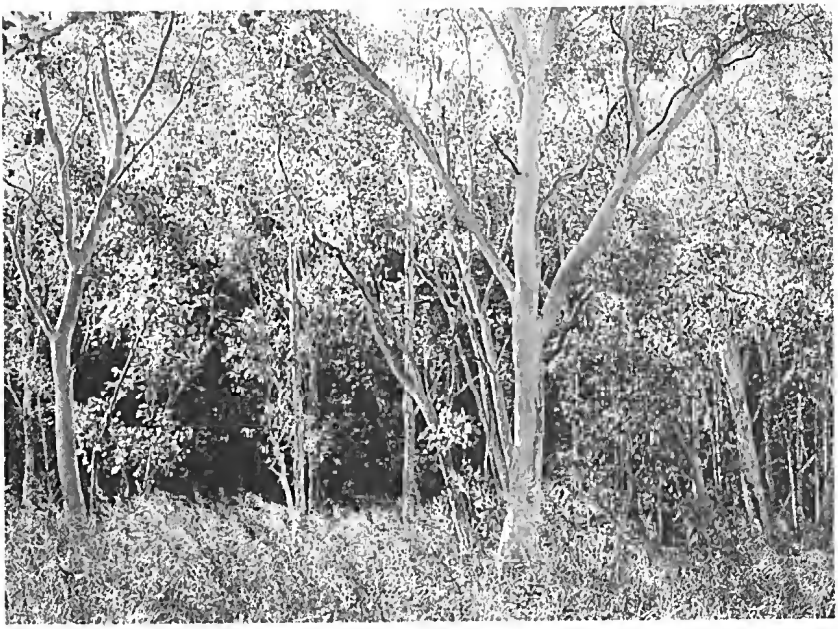


Figure 7. Edge of gallery forest fringing Calder River, dominated by *Eucalyptus houseana*.

americanus, *Ilex arnhemensis*, *Miliusa brahei*, *Mimusops elengi*, *Polyalthia australis*, *Polyaulax cylindrocarpa*, *Pouteria sericea* and *Wrightia pubescens*. The vines include *Abrus precatorius*, *Adenia heterophylla*, *Ampelocissus acetosa*, *Canavalia papuana*, *Capparis sepiaria*, *Flagellaria indica*, *Ichnocarpus frutescens*, *Pachygone ovata*, *Parsonsia velutina*, *Pisonia aculeata* and *Secamone timoriensis*. The epiphytic orchid *Dendrobium affine* occasionally occurs.

A low or open woodland covers the sandstone slopes and plateaus, interspersed in places with tall shrubland and hummock grassland (Fig.11). Typical trees include woolybutt (*Eucalyptus miniata*), grey box (*E. tectifica*), bloodwoods (*E. greeniana* and *E. polycarpa*), *E. brachyandra*, *Callitris intratropica*, *Terminalia hadleyana* and *T. volucris*, whitewood (*Atalaya hemiglauca*), quinine tree (*Petalostigma pubescens*), *Buchanania obovata*, bauhinia (*Lysiphyllum cunninghamii*), *Gardenia megasperma* and *Owenia vernicosa* (Figs 12 & 13). Shrubs include *Acacia* species (including the rarely collected *A. froggattii*) and *Calytrix exstipulata*. Common grasses include *Panicum mindanaense*, *Plectrachne pungens*, spear grass (*Heteropogon contortus*) and *Cymbopogon ambiguus*.

Rivers and creeks flowing through sandstone are fringed by stately cadjeputs (*Melaleuca leucadendra*) over thickets of screw palm (*Pandanus spiralis*).

Semi-permanent or permanent swamps or billabongs are found in the area, the largest example being Munja Lagoon. These wetlands are dominated by the blue waterlily (*Nymphaea violacea*) and are often fringed with dense beds of the sedge, *Eleocharis dulcis* (Fig.14). The grass *Pseudoraphis spinescens* is common as are the submerged aquatics *Blyxa aubertii* and *Najas tenuifolia*.

Figure 8. Buttressed roots of *Syzygium nervosum* in gallery forest.

ETHNOBOTANY

The survey team was accompanied by Wattie Ngerdu, an elder of the Worora tribe from Mowanjum who was responsible for liaison (Fig.15). During the expedition he worked with us providing a wealth of traditional knowledge of the area and its wildlife. Where possible Aboriginal names were provided for plants and these have been transcribed by the author and recorded in the annotated plant list.

Figure 9. Climbing Swamp Fern (*Stenochlaena palustris*), on trunk of *Syzygium angophoroides*.

CONSERVATION SIGNIFICANCE

The most significant aspects of the Walcott Inlet is that unlike other large inlets in the north Kimberley, it includes extensive alluvial, black soil plains supporting gallery forests, rainforest, savanna and permanent wetlands. Other inlets such as the St. George Basin, Prince Frederick Harbour and Port Warrender are fringed by rugged scree, escarpment and hill country that are fronted by mangroves.

Figure 10. *Helminthostachys zeylanica*, a rarely collected fern in the gallery forest.

Feral stock are present in limited numbers and the vegetation is in reasonably good condition. Fire ecology in the study area requires further investigation. The absence of permanent settlement reduces a significant source of ignition although some temporary camping takes place at Munja during stock mustering from nearby Pantijan Station.

A number of species of significance occur within the study area. These include *Borya subulata* (Anthericaceae), *Monochoria vaginalis*

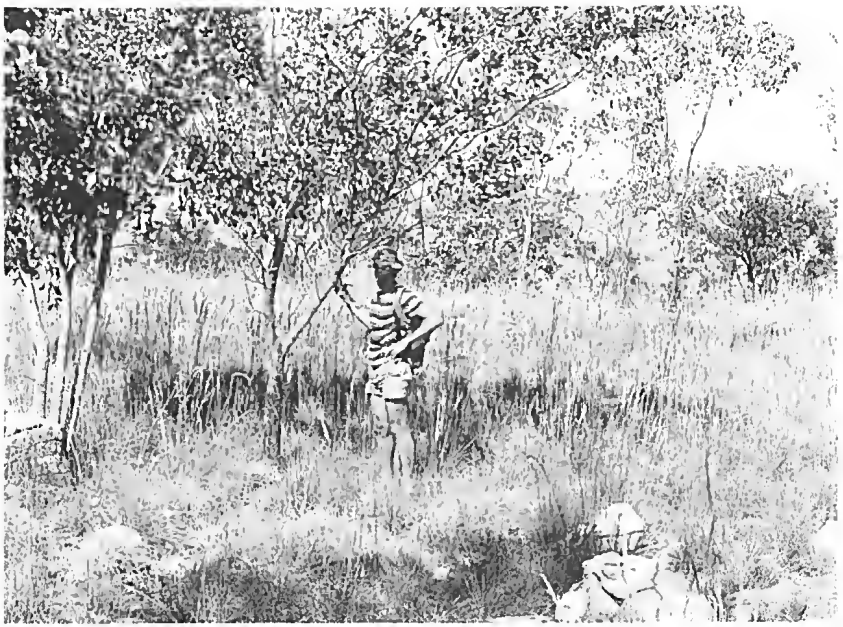


Figure 11. Hummock grassland in sandstone dominated by *Grevilllea refracta* and *Terminalia hadleyana*.

(Pontederiaceae), *Merremia gemella* (Convolvulaceae), *Kalanchoe crenata* (Crassulaceae), *Decaisnina biangulata* (Loranthaceae), *Acacia froggattii* (Mimosaceae), *Syzygium nervosum* (Myrtaceae) all of which appear restricted to the study area (Kenneally, 1983; Wheeler *et al.* 1992).

This survey is by no means comprehensive and communities and species need additional surveys, particularly during the wet season.

The area to the west of the study area has been proposed as a Class A reserve for the purpose of a National Park. It has been suggested that once the reserve is gazetted, the National Parks Authority explore with the occupants of Pantijan Station the possibility of joint participation in management of the Park. Munja Lagoon (within the study area) has been specifically mentioned as one of the few permanent fresh water swamps in the north Kimberley. It provides suitable habitat for north-west Kimberley populations of the Comb-crested Jacana and numerous other wetland birds through the dry season (Burbidge et al. 1991).

ACKNOWLEDGEMENTS

The authors are indebted to members of the 1983 Australian and New Zealand Scientific Exploration Society (ANZSES) Kimberley Expedition and to members of the 1987 & 1988 Kimberley Rainforest Study Teams for their assistance in the collection of specimens.

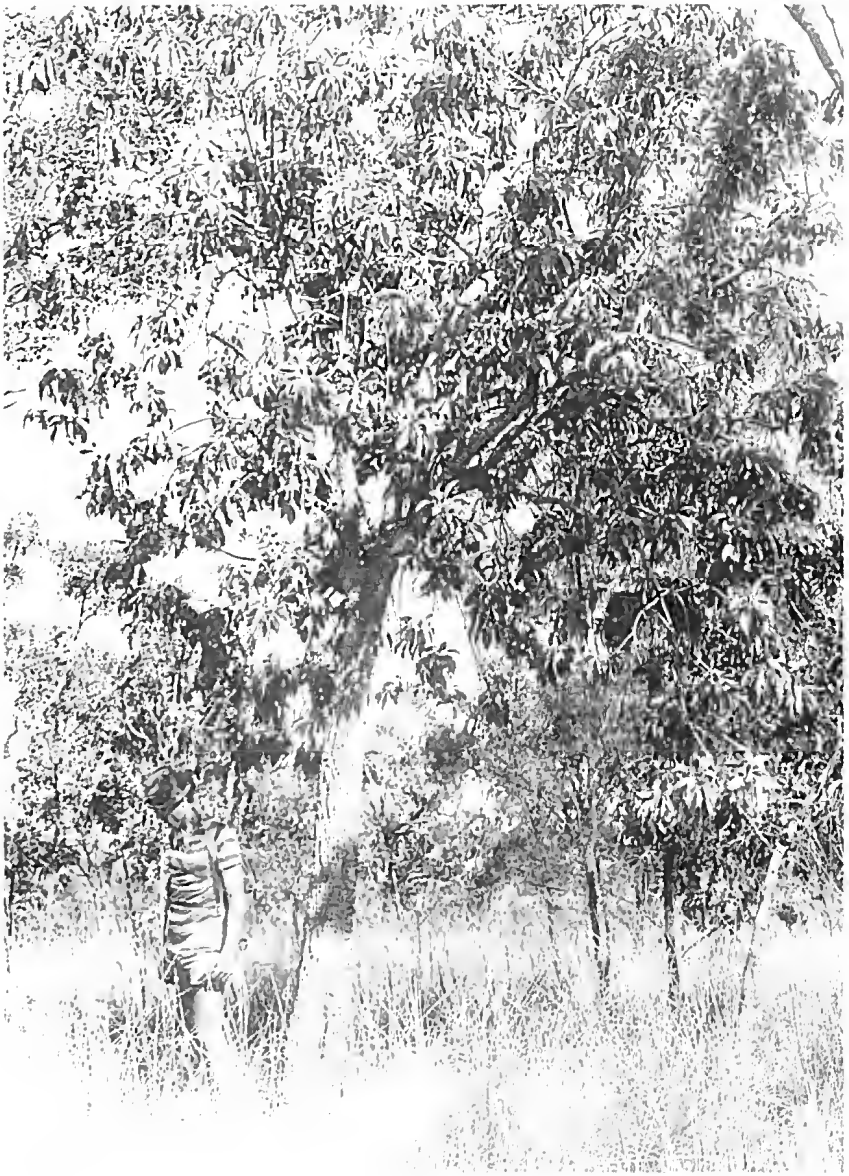


Figure 12. *Pouteria arnhemica* on sandstone.

The advice and companionship of the late Wattie Ngerdu in helping to understand the traditional Aboriginal significance of the area will always be deeply appreciated.

The assistance with identifications has been given by our colleagues at the Western Australian Herbarium and at interstate herbaria. The assistance of Herbarium technical staff in the processing of loans is gratefully appreciated.

Mr Ian Elliott, Geographic Names Subsection, Department of Land

Figure 13. Fissured, corky bark of *Pouteria arnhemica*.

Figure 14. Billabong below sandstone escarpment dominated by blue waterlilies (*Nymphaea violacea*) and chinese water chestnut (*Eleocharis dulcis*). Both plants have edible tubers.

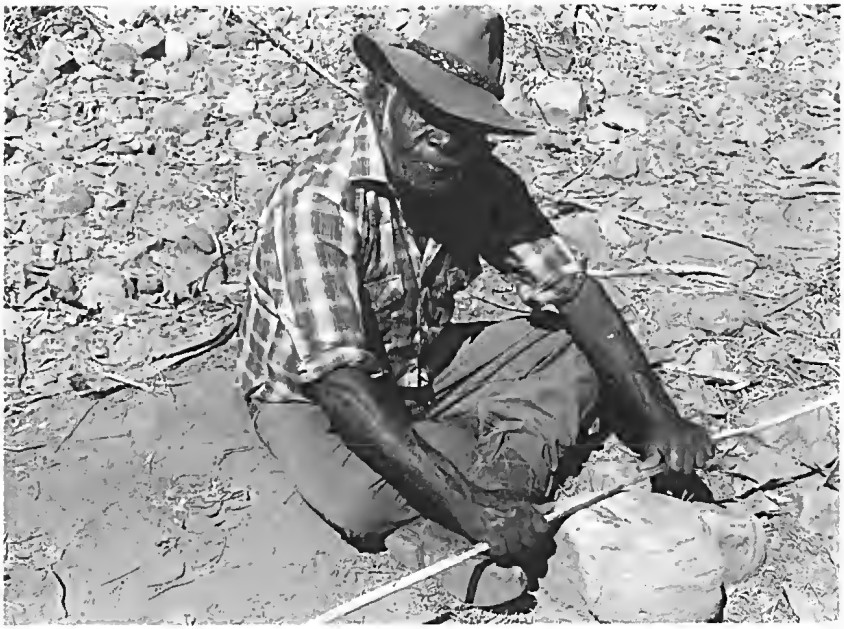


Figure 15. Watti Ngerdu making a spear from *Acacia tumida*.

Administration kindly provided information on land tenure in the Walcott Inlet.

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AN ANNOTATED PLANT CHECKLIST OF WALCOTT INLET, NORTH KIMBERLEY WESTERN AUSTRALIA

ARRANGEMENT OF THE PLANT CHECKLIST

Genera and species are arranged alphabetically within the families which are themselves arranged alphabetically in each section. Introduced plants are indicated by an asterisk (*). Species are followed by the collector's initials, a collector's number or numbers to assist location of the voucher collections. A list of collectors is given at the end of the list. All specimens cited are represented by voucher specimens housed in the Western Australian Herbarium (PERTH), unless indicated by (SR) which denotes a sight record only.

PTERIDOPHYTA (Ferns and Fern Allies).

ADIANTACEAE

Ceratopteris thalictroides (L.) Brongn. CD s.n.; KFK 8755.

Fern in gallery forest, in black peat soil in inundated area of forest fringing an unnamed creek flowing from a sandstone gorge, Calder River.

Cheilanthes contigua Baker AVM 23.

Rhizomatous fern 0.2 m. Occasional in woodland with *Adansonia gregorii* and other mixed species on basalt boulder scree slope with brown loam soil at junction of Brockman and Calder Rivers.

Doryopteris concolor (Langsd. & Fisch.) Kuhn AVM 176.

Rhizomatous fern 20 cm, starting to dessicate. Occasional in mixed forest on boulder-strewn forest floor in a small opening of dense vine thicket, over basalt in red-brown loam at Neville Creek.

Paraceterach muelleri (Hook.) Copel JJA & GJK 1385; KFK 10455.

Small rhizomatous fern to 15 cm. Abundant on edge of cliffs in semi-deciduous vine thicket in valley. In red loam over Warton Sandstone, NW of Mt Daglish in Harding Range.

BLECHNACEAE

Stenochlaena palustris (Burm.f.) Bedd. JJA & GJK 1331; KFK 8738.

Climbing fern with *Acrostichum speciosum* in black peat soil in inundated area of gallery forest fringing an unnamed creek flowing from a sandstone gorge of Calder River, and common in *Nauclea orientalis* forest-riverine flats of inundated black clay soil at mouth of Isdell River.

LYGODIACEAE

Lygodium microphyllum (Cav.) R.Br. JJA & GJK 1328; CD s.n.

Twining fern climbing on trees in gorge at water's edge in *Nauclea orientalis* forest, on riverine flat in black clay soil at mouth of Isdell River.

MARSILIACEAE

Marsilea hirsuta R.Br. CAG 1087

Walcott Inlet

Marsilea mutica Mett DJE 9.

Aquatic fern. Abundant in gallery forest swamp on a pavement of King Leopold Sandstone in black peaty soil, Calder River.

OPHIOGLOSSACEAE

Helminthostachys zeylanica (L.) Hook. KFK 8734, 10473.

Rhizomatous fern with *Acrostichum speciosum*. Growing in black peat soil in inundated area of gallery forest fringing an unnamed creek flowing from a sandstone gorge, Calder River.

PLATYZOMATACEAE

Platyzoma microphyllum R.Br. WRE 1032.

Fern in swampy, sandy spots, Calder River.

PTERIDACEAE

Acrostichum speciosum Willd. JJA & GJK 1330; CD s.n.; KFK 8733, 8764.

Clumped fern forming dense thickets to 2 m. Growing in billabongs and inundated areas of closed gallery forest, fringing an unnamed creek flowing from a sandstone gorge of Calder River, and mouth of Isdell River.

THELYPTERIDACEAE

Cyclosorus interruptus (Willd.) H.Ito JJA & GJK 1329; KFK 8737.

Fern with *Acrostichum speciosum* in black peat soil in inundated area of gallery forest fringing an unnamed creek flowing from a sandstone gorge of Calder River, and abundant in *Nauclea orientalis* forest-riverine flats in inundated black clay at mouth of Isdell River.

SPERMATOPHYTA

GYMNOSPERMAE

CUPRESSACEAE

Callitris intratropica (F.Muell.) R.Baker DF 23.

Small tree to 3 m. On dry open heath associated with scattered boabs, *Acacia* and *Eucalyptus* species, on sandstone in yellow sandy soil, Harding Range.

ANGIOSPERMAE

MONOCOTYLEDONAE

ALISMATACEAE

Caldesia oligococca (F.Muell.) Buchenau. KFK 8730.

Emergent aquatic, flowers white. On edge of billabong abutting King Leopold sandstone with *Adansonia gregorii* and *Terminalia canescens*, Calder River.

ANTHERICACEAE

Borya subulata C.Gardner KFK 10522.

Rhizomatous plant forming dense spreading sward in sand over sandstone pavement. S of Mt Daglish in Harding Range.

ARACEAE

Amorphophallus galbra Bailey AVM 177.

Woody herb 50 cm, seen once only. In red-brown loam in mixed forest, boulder-strewn in slight seepage area in deep shady gorge over basalt, Neville Creek.

ARECACEAE

Livistona loriphylla Becc. KFK (SR)

Palm to 7 m. On sandstone, Isdell River.

CENTROLEPIDACEAE

Centrolepis exserta (R.Br.) Roemer & Schultes CD s.n.

In sand on river bank, 3-4 miles from Charnley River mouth. Fl. Aug.

COMMELINACEAE

Commelina cyanea R. Br. DJE 7.

Prostrate creeper, flowers blue. Calder River. Fl. May

Commelina ensifolia R.Br. DJE 2, 18, 37, 43.

Prostrate scrambler, leaves narrow, flowers pale to bright blue. Frequent in moist patches in grassy woodland of alluvial floodplain and occasional on raised sandbank above river floodplain on edge of forest below rugged, boulder-strewn plateau of King Leopold Sandstone, Calder and Charnley Rivers. Fl. May.

Commelina reticulata Stanley DJE 5, 50.

Prostrate creeper, leaves very fine, flowers pale to bright blue. In moist to swampy loamy soil of alluvial floodplain over King Leopold Sandstone, Calder River. Fl. May.

CYPERACEAE

Cyperus aquatilis R.Br CD s.n.

Sedge. Beside Charnley River, right bank 3-4 miles above mouth. Fl. Aug.

Cyperus difformis L. CD s.n.

Sedge. In damp soil by billabong at Munja and bank of Charnley River. Fl. Aug.

Cyperus haspan L. subsp. *haspan* WVF 1452.

Walcott Inlet.

Cyperus haspan L. subsp. *juncoides* (Lam.) Kuk. JJA & GJK 1335.

Spreading herbaceous sedge, inflorescence brown to pale green. Common in riverine forest in inundated black clay with *Nauclea orientalis*, mouth of Isdell River. Fl. June.

Cyperus javanicus Houtt. JJA & GJK 1325; KFK 10912.

Erect rough sedge to 70 cm, inflorescence pale brown. Abundant on inundated black clay, mouth of Isdell River. Fl. June.

Cyperus microcephalus R.Br. subsp. *microcephalus* KFK 11151

Sedge to 0.8 m, growing in cracks of massive sandstone, mouth of Isdell River. Fl. & Fr. May.

Cyperus tenuispica Steudel CD s.n.

Sedge, beside small permanent pool. Flats below Harding Ranges about 8 miles WNW Munja Station. Fl. Aug.

Cyperus vaginatus R.Br. CD s.n.

Sedge in wet sand, beside Charnley River, 3-4 miles above mouth. Fl. Aug

Cyperus viscidulus K.L.Wilson KFK 8706, 11146.

Caespitose sedge, inflorescence pale yellow. In alluvial soil, Neville Creek and mouth of Isdell River. Fl. & Fr. May.

Cyperus zollingeri Steudel DJE 30.

Sedge to 15 cm. Occasional in forest on raised sandbank above river floodplain and at edge of forest below rugged boulder-strewn plateau of King Leopold Sandstone in light brown sandy clay, Charnley River.

Eleocharis affin. *brassii* S.T.Blake KFK 8727.

Sedge, forming dense stand on edge of billabong which abuts King Leopold Sandstone with *Adansonia gregorii* and *Terminalia canescens*, Calder River.

Eleocharis dulcis (Burm.f.) Trin. ex Hensch. CD s.n.

Emergent aquatic in billabong at Munja and Isdell River.

Fimbristylis arthrostyloides W. Fitzg. JJA & GJK s.n.

Tall, slender sedge to 60 cm. In pockets of soil in rock face crevices in vine thicket, NW of Mt Daglish in Harding Range. Fl & Fr. June.

Fimbristylis ferruginea (L.) Vahl. JJA & GJK 1336.

Erect sedge to 45 cm, inflorescence pale yellow. Common in riverine forest in black clay inundated with *Nauclea orientalis*, mouth of Isdell River. Fl. June.

Fimbristylis littoralis Gaud. CD s.n.

Sedge in wet river sand, on right bank 3-4 miles above mouth of Charnley River.

Fimbristylis microcarya F.Muell. CD s.n.; DJE 20.

Sedge 20-30 cm. Occasional in woodland, and by small creek, on bank near billabong over sandstone with reddish-brown sandy clay, Calder and Charnley Rivers.

Fimbristylis tetragona R.Br. CD s.n.

Sedge in limestone gorge, left bank of Isdell River, 12 miles from mouth.

Fimbristylis sp. L Kimb. Flora CD s.n.

Sedge in wet sand beside river, 3-4 miles above mouth of Charnley River.

Fuirena sp. CD s.n.

Sedge in wet sand, beside Charnley River. Fl. Aug.

Schoenoplectus praelongatus (Poiret) Raynal CD s.n.

Sedges in billabong at Munja Station, and in wet sand beside Charnley River on right bank 3-4 miles above mouth. Fl. & Fr. Aug.

Scleria brownii Kunth. KFK 11153

Caespitose sedge in fissures below massive sandstone, mouth of Isdell River. Fl. & Fr. May.

Scleria polycarpa Boeck. KFK 10779.

Caespitose sedge near and in swamp, 6 km E of Mt Talbot. Fl. & Fr. June.

DIOSCOREACEAE

Dioscorea bulbifera L. KFK (SR).

Climber, fruits narrowly winged. In vine thicket mouth of Isdell River. Fl. & Fr. Jan.

ERIOCAULACEAE

Eriocaulon cinereum R.Br. CD s.n.; DF 36.

Aquatic herb 10 cm, flower-heads white. Growing in small pool in scrub of rocky sandstone gorge of upper Neville Creek and in permanent spring in ranges between mouths of Charnley and Calder Rivers. Fl. May & Aug.

Eriocaulon sp. B. Kimb. Flora CD s.n.

Semi-aquatic herb in wet sand by river, above mouth of Charnley River. Fl. Aug.

FLAGELLARIACEAE

Flagellaria indica L. JJA & GJK 1332; CD s.n.; AVM 196.

Woody climber to 4 m, occasional ripe fruits present. In small patch of monsoon forest or vine thicket along seasonal stream feeding the Charnley River at base of 10 m high abrupt plateau of King Leopold Sandstone, also at Isdell River. Fr. May.

HYDROCHARITACEAE

Blyxa aubertii Rich. var. *aubertii* KFK 8735, 10448.

Submerged aquatic with *Acrostichum speciosum*, in black peat soil in inundated area of gallery forest fringing an unnamed creek flowing from a sandstone gorge of Calder River.

LEMNACEAE

Lemna aequinoctialis Weber KFK 10450B & C, 10643.

Floating aquatic in pools in forest.

NAJADACEAE

Najas tenuifolia R.Br. KFK 8728.

Emergent aquatic, leaves red. In billabong which abuts King Leopold Sandstone with *Adansonia gregorii* and *Terminalia canescens* dominant, Calder River.

ORCHIDACEAE

Cymbidium canaliculatum R.Br. CAG 1527.

Epiphytic orchid, Isdell River. Fl. Sept.

Dendrobium affine (Decne) Steudel DF 43; KFK 10466; AVM 162.

Epiphytic orchid 4 m, in bud. Occasional in forest in basaltic rocky gorge with reddish-brown clayey sand; also in mixed forest of a shady, large boulder-strewn ephemeral watercourse below a sandstone scarp over basalt in brown skeletal soil, Neville Creek and Harding Range.

POACEAE

Arundinella nepalensis Trin. KFK 8704.

Caespitose grass, common in alluvial sand over sandstone, Calder River.

Bothriochloa bladhii (Retz.) S.T.Blake KFK 8700.

Caespitose grass, inflorescence straw-coloured. Forms dense closed stands in alluvial sand beside creek in sandstone, Neville Creek.

Brachyachne convergens (F.Muell.) Stapf KFK 8709.

Grass, in sand of alluvial floodplain over sandstone, Neville Creek.

Cenchrus elymoides F.Muell. AVM 24.

Grass to 1 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, on a boulder scree slope over basalt with brown loam at mouth of Brockman River.

Coelorhachis rottboelloides (R.Br.) A.Camus KFK 8701.

Caespitose grass to 1.5 m. Common with couch and *Bothriochloa bladhii*. In sand on alluvial floodplain and in sandstone at Neville Creek mouth.

Cymbopogon ambiguus A.Camus AVM 75A.

Caespitose grass 50 cm. Frequent in woodland with *Adansonia gregorii* on King Leopold Sandstone in yellow sand, Charnley River.

Cymbopogon procerus (R.Br.) Domin AVM 34.

Caespitose grass 0.5-1 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, on boulder scree slope over basalt in brown loamy soil, Brockman River mouth.

Cynodon dactylon (L.) Pers. KFK 8699.

Couch grass, creeping and rooting at nodes, common in sand of alluvial floodplain beside creek, over sandstone, Neville Creek.

Digitaria bicornis (Lam.) Roemer & Schultes GJK 10653; AVM 197.

Grass forming diffuse tufts to 1 m. In sunny openings under *Adansonia gregorii* and other species in forest on sandy levee bank of river, near edge of a patch of monsoon forest and vine thicket, Charnley River and mouth of Isdell River. Fl & Fr. March.

**Digitaria ciliaris* (Retz.) Koeler DJE 28; KFK 8707.

Rhizomatous grass 20 cm. Occasional in grassland on raised sandbank above river floodplain and below a rugged boulder-strewn plateau of King Leopold Sandstone in brownish sand at Charnley River and Neville Creek.

**Echinochloa colona* (L.) Link GJK 10716; KFK 8763.

Grass in black mud at edge of gallery forest by Calder River and mouth of Isdell River. Fl. & Fr. March.

Elytrophorus spicatus (Willd.) A.Camus CD s.n.

Grass in wet sand on right bank of Charnley River, 3-4 miles above mouth.

Eragrostis cumingii Steudel CD s.n.; DJE 19.

Grass 1 m. Occasional in woodland on bank of creek upstream of river over sandstone in reddish-brown sandy clay, Neville Creek and in wet sand beside Charnley River.

Eragrostis tenellula (Kunth) Steudel CD s.n.; KFK 8708.

Grass, in sand of alluvial floodplain near Neville Creek on underlying sandstone and in wet sand, Charnley River.

Eriachne festucacea F.Muell. KFK 8718A.

Grass on damp seepage area of bank of Calder River near junction with Neville Creek.

Heteropogon contortus (L.) P. Beauv. ex Roemer & Schultes KFK (SR).

Common grass in area.

Imperata cylindrica (L.) P.Beauv. var. *major* (Nees) C.E.Hubb. WVF 1447; AVM 75.

Grass 0.5-1 m. Occasional in grassland with other mixed tall grasses on river bank in brown sandy clay, Charnley River and near mouth Calder River.

Ischaemum australe R.Br. var *australe* KFK 8717.

Caespitose grass forming dense clump beside creek joining Calder River. On alluvial floodplain over sandstone in sandy soil, Neville Creek.

Iseilema fragile S.T.Blake KFK 8725.

Grass, in seepage areas of floodplain over sandstone between the Calder River and Mt Daglish in the Harding Range.

Panicum mindanaense Merr. AVM 10.

Caespitose grass 0.5 m. Occasional in woodland with *Adansonia gregorii* and other mixed species on boulder scree slope over basalt in brown loamy soil, Brockman River mouth.

Panicum trachyrhachis Benth. KFK 8729.

Dominant grass on floodplain adjacent to billabong in dense, high, closed grassland to 2 m. Occurs with scattered *Eucalyptus houseana* and other grasses such as *Rottboellia* and *Pennisetum*. Billabong abuts King Leopold Sandstone with *Adansonia* and *Terminalia*, Calder River.

Panicum trichoides Sw. JJA & GJK 1343, 1390; GJK 10691.

Creeping grass to 10 cm. Abundant on edge of semi-deciduous vine thicket. In valley in red loam and sand over Wharton Sandstone, NW of Mt Daglish, Harding Range, and mouth of Isdell River. Fl. & Fr. March.

Paspalum scrobiculatum L. GJK 10622

Erect annual grass to 60 cm. In tall *Nauclea orientalis* riverine vine forest in wet peaty black loam, mouth of Isdell River. Fl. & Fr. March.

Perotis rara R.Br. DJE 27.

Grass 25 cm. Occasional in grassland on raised sandbank above river floodplain and below a rugged boulder-strewn plateau over King Leopold Sandstone in brown sand, Charnley River.

Pseudoraphis spinescens (R.Br.) Vick. KFK 8732.

Grass, inflorescence emergent. In billabong on east bank of Calder River, on floodplain in dense, high, closed grassland to 2 m. Billabong abuts King Leopold Sandstone with *Adansonia* and *Terminalia*, Calder River.

Setaria apiculata (Scribn. & Merk.) K. Schum. GJK 10654.

Annual grass to 30 cm, flower spike green and purple. Uncommon in riverine vine forest at edge of creek in black peaty clay, mouth of Isdell River. Fl. & Fr. March.

Urochloa pubigera (Roemer & Schultes) R. Webster DJE 26; GJK 10623.

Rhizomatous grass 30 cm, occasional in grassland on raised sandbank above river floodplain and below rugged boulder-strewn plateau over King Leopold Sandstone, in pale brown sand, Charnley River and common in riverine forest, mouth of Isdell River. Fl. & Fr. March-May.

PONTEDERIACEAE

Monochoria cyanea (F. Muell.) F. Muell. KFK 10907.

Emergent aquatic in gallery forest at mouth of Isdell River.

Monochoria vaginalis (Burm.f.) Presl DJE 8; KFK 8736.

Emergent aquatic, flowers blue. With *Acrostichum speciosum* in black peat swamp under gallery forest, Calder River. Fl. May.

SMILACACEAE

Smilax australis R.Br. AVM s.n.; KFK 8745.

Creeper, flowers white. Growing in black peat in inundated area of forest fringing an unnamed creek flowing from a sandstone gorge by Calder River, also at Charnley River. Fl. May.

TACCACEAE

Tacca leontopetaloides (L.) Kuntze KFK (SR).

Bulbous perennial, leaf segments broad. In vine thicket at mouth of Isdell River.

XYRIDACEAE

Xyris complanata R.Br. CAG 907, 1407.

Herb, flowers yellow. At source of Calder River.

Xyris oligantha Steudel CD s.n.

Small herb to 13 cm, flowers orange-yellow. By permanent spring in wet soil in Ranges at 170 m, and between mouths of Charnley and Calder Rivers. Fl. Aug.

DICOTYLEDONAE

ACANTHACEAE

Dicliptera armata F.Muell. AVM 28.

Prostrate woody herb 0.5 m. Occasional in woodland with *Adansonia gregorii* and other mixed species on basalt boulder scree slope in brown loam, Brockman River mouth.

Hypoestes floribunda R.Br. AVM 220.

Shrub to 1 m. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone 10 m above level of river, in pale, sandy, skeletal soil, Charnley River.

AMARANTHACEAE

Achyranthes aspera L. JJA & GJK 1334; AVM 175.

Woody herb. Occasional among sandstone boulders in mixed forest in shady ephemeral watercourse below a sandstone scarp over underlying basalt in brown skeletal soil, Neville Creek and mouth of Isdell River. Fr. June.

Alternanthera sp. DJE 22.

Prostrate herb. Occasional in woodland in clayey red-brown soil over sandstone, Calder River.

Amaranthus pallidiflorus F.Muell. JJA & GJK 1396; KFK 10910.

Spreading herb to 15 cm, flowers pale green. Uncommon in savannah woodland in reddish-brown loamy soil near Mt Daglish vine thicket and on edge of gallery forest, mouth of Isdell River. Fl. June.

Deeringia amaranthoides (Lam.) Merr. JJA s.n.

Climber in vine thicket of Harding Range.

Gomphrena diffusa (R.Br.) Spreng. AVM s.n.

Small herb, flowers cream. On sandstone by Charnley River. Fl. May.

Gomphrena flaccida R.Br. DJE 14.

Woody herb to 50 cm, flowers pink. Frequent on edge of King Leopold Sandstone exposure among grasses fringing gallery forest, Calder River. Fl. May.

Gomphrena leptoclada Benth. AVM 6.

Prostrate woody herb 0.6 m, flowers dark pink and white. Occasional in woodland with *Adansonia gregorii* and other mixed species on basalt boulder scree slope in brown loam soil, junction of Brockman and Calder Rivers. Fl. May.

ANACARDIACEAE

Buchanania obovata Engl. KFK 8757.

Tree to 4 m, flowers white. In massive King Leopold Sandstone, abutting floodplain with *Adansonia gregorii*, *Xanthostemon paradoxus*, *Terminalia spp.* and *Brachychiton* sp., Calder River. Fl. May.

**Mangifera indica* L. KFK 8747, 10476.

Tree to 6 m, leaves dark green. In black peat soil in inundated area of gallery forest fringing an unnamed creek flowing from a sandstone gorge, Calder River. A probable escape from nearby abandoned Munja Settlement.

ANNONACEAE

Miliusa brahei (F.Muell.) Jessup DF 17; KFK 8748; AVM 96.

Small tree to 5 m, leaves discolorous, upper leaves dark shiny green, lower leaves light green. Growing in black peaty soil in gallery forest on alluvial plain on edge of King Leopold Sandstone, with *Ficus*, *Flagellaria*, *Syzygium*, *Adansonia gregorii* and other mixed species, Calder and Charnley Rivers.

Polyalthia australis (Benth.) Jessup KFK 8781; AVM 192.

Tree to 8 m in full flower, flowers pale yellow, fragrant; bark smooth. In black peat soil in inundated area of gallery forest fringing an unnamed creek flowing from a sandstone gorge by the Calder River, and occasionally in mixed forest near boulder strewn watercourse at foot of sandstone scarp over basalt rock in red-brown skeletal soil, Neville Creek. Fl. May.

Polyaulax cylindrocarpa (Burk.) Backer AVM 128.

Small tree, fruits ripe, fleshy, edible-looking, orange. Frequent in mixed forest in a shady ephemeral watercourse strewn with large boulders, and below a sandstone scarp over underlying basalt rock on brown skeletal soil of narrow gorge, Neville Creek. Fr. May.

APIACEAE

Trachymene didiscoides (F.Muell.) B.L.Burtt AVM 208.

Woody herb to 1 m. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone 10 m above river level in pale sandy skeletal soil, Charnley River.

Trachymene microcephala (Domin) B.L. Burtt JJA 555.

Woody herb to 60 cm, flower yellow. In *Eucalyptus - Terminalia* savanna woodland near Mt Daglish vine thicket. Fl. June.

APOCYNACEAE

Alstonia linearis Benth. JJA s.n.

Tree in vine thicket, Mt Daglish in Harding Range.

Ichnocarpus frutescens (L.) R.Br. JJA s.n.

Climber in vine thicket, Mt Daglish.

Parsonsia velutina R.Br. JJA s.n.; KFK 10913; AVM 147.

Climbing woody vine to 3 m, fruit green. Occassional in woodland with *Lophostemon* on rocky bank of perennial creek over basalt in brown clayey sand, Neville Creek and gallery forest at mouth of Isdell River and vine thicket at Mt Daglish. Fr. May.

Tabernaemontana pandacaqui Lam. JJA & GJK 1388; CD s.n.; KFK 8716; AVM 120.

Open shrub or tree 3 to 5 m, flowers white; leaves glabrous or pubescent, fruits bright orange. In riverine forest by creek in foothills of Harding Range. Common in alluvial sand and found frequently in mixed forest in a shady ephemeral watercourse strewn with large boulders and below a sandstone scarp over underlying basalt rock in brown skeletal soil, Neville Creek and Mt Daglish. Previously known as *Tabernaemontana orientalis* R. Br. Fl. & Fr. May-June.

Wrightia pubescens R.Br. JJA s.n.

Tree to 10 m with milky exudate, in vine thicket, Mt Daglish.

AQUIFOLIACEAE

Ilex arnhemensis (F.Muell.) Loes. subsp. *arnhemensis* BH 25518 RFK.

Tree to 10 m, blaze turns purple immediately in cambial layer. Mouth of Isdell River.

ASCLEPIADACEAE

Gymnanthera nitida R.Br. JJA & GJK 1345.

Climbing twiner abundant in riverine forest in black soil, mouth of Isdell River.

Sarcostemma viminale (L.) R.Br. subsp. *brunonianum* (Wight & Arn.) P. Forster AVM 158.

Climbing woody, succulent herb 2-4 m. Occasional in mixed forest in shady, ephemeral watercourse strewn with large boulders and below a sandstone scarp over underlying basalt, in brown skeletal soil of narrow gorge, Neville Creek.

Secamone timoriensis Decaisne JJA & GJK 1378.

Climber common in deciduous vine thicket, Mt Daglish.

Tylophora flexuosa R.Br. JJA s.n.; KFK 10469.

Twiner, leaves glossy green above, pale greyish green below, Mt Daglish and near Mt Talbot.

ASTERACEAE

Adenostemma lavenia (L.) Kuntze GJK 10625; KFK 8739, 10456.

Herb, flowers white. Growing in flowing water of small creek with *Acrostichum speciosum*, in black peat in inundated area of gallery forest fringing an unnamed creek flowing from a sandstone gorge into Calder River, and mouth of Isdell River. Fl. March-June.

Bidens bipinnata L. GJK 10657.

Slender erect herb to 1.5 m, flowers yellow. Abundant in riverine vine forest on river flats in black peaty loam at mouth of Isdell River. Fl. March.

Blumea axillaris (Lam.) DC. CD s.n.; KFK 10472.

Erect aromatic herb to 80 cm, leaves greyish green, flowers mauve. Beside small permanent pool on flats below Harding Range, and in black mud in open area of swamp in gallery forest by Calder River. Fl. June, Aug.

Blumea lacera (Burm.f.) DC. WVF 1385.

Herb, on flats below Harding Range near Munja. Fl. Aug.

Chrysogonum ecliptoides (F.Muell.) F.Muell. DD 6; DJE 42.

Straggly shrub to 70 cm, flowers small, bright yellow. On steep, north-facing sandstone slope and occasionally in woodland atop a rugged, boulder-strewn sandstone plateau, in light brown sandy soil, at junction of Charnley and Calder Rivers. Fl. May.

Pterocaulon sphacelatum (Labill.) F.Muell. DF 3; CAG 1085; AVM 51.

Woody herb to 2 m, stem brown, leaves light green, very hairy and aromatic, flowers in terminal heads. Abundant in grassland of the alluvial floodplain and occasionally in woodland with *Adansonia gregorii* and other mixed species. Soil brownish-black sandy clay at junction of Brockman and Calder Rivers and at Munja. Fl. May - Sept.

Streptoglossa odora (F.Muell.) Dunlop CD s.n.

Aromatic herb, beside small permanent pool on flats below Harding Range, near Munja. Fl. Aug.

Vernonia cinerea (L.) Less. WVF 1456; AVM 19.

Woody herb 0.5 m. Occasional in woodland with *Adansonia gregorii* and other mixed species on basalt boulder scree slope with brown loam soil at junction of Brockman and Calder Rivers and Mt Daglish. Fl. May, Aug.

AVICENNIACEAE

Avicennia marina (Forsskal) Vierh. KFK (SR).

Mangrove on narrow levee banks abutting steep sandstone cliffs at mouth of Charnley River.

BOMBACACEAE

Adansonia gregorii F.Muell. BH 25530 RFK; KFK(S.R.); JRBL s.n.

Tree to 8 m, deciduous at time of survey, some fruits remaining. Growing in alluvial soil of levee flats, Munja, and mouth of Isdell River. Fl. Dec.

Bombax ceiba L. KFK 8777; AVM s.n.

Tree to 12 m, almost deciduous at time of survey, bark silver-grey with thorns. Growing in black peat on edge of gallery forest fringing an unnamed creek flowing from a sandstone gorge. Calder and Charnley Rivers.

BORAGINACEAE

Cordia dichotoma G.Forster DF 12.

Tree to 8 m. Occasional in gallery forest with *Ficus* sp. and *Flagellaria* bordered by *Melaleuca leucadendra*, *Pandanus spiralis* and *Eucalyptus houseana*, in a deposition zone fed by a spring, surface run-off and sub-surface flow at the junction of a sandstone (King Leopold) outcrop and alluvial plain in black peaty sand, Calder River.

Cordia myxa L. BH 25145 RFK; KFK 10477.

Tree to 10 m, bark tessellated, flaky, blaze cream, fibrous layered, rapidly darkening to olive, inner blaze cream, also darkening rapidly, sub-rhytidome cream. In gallery forest south of Mt Daglish by Calder River.

BURSERACEAE

Canarium australianum F.Muell. DF 28A; BH 25533 RFK.

Tree 5 m. Abundant in forest and scrub at the head of a craggy gorge of sandstone with *Ficus* and *Brachychiton*, Harding Range, and mouth of Isdell River.

Garuga floribunda Decne AVM s.n.

Tree, in forest above river camp, Charnley River.

BYBLIDACEAE

Byblis liniflora Salisb. DD 7.

Small herb 15 cm, flowers very delicate, lilac. Occasional on rock face in well-watered grey soil, over sandstone, Charnley River. Fl. May.

CAESALPINIACEAE

Erythrophleum chlorostachys (F.Muell.) Baillon AVM 42.

Tree 3-4 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, on basalt boulder scree slope in brown loam at junction of Brockman and Calder Rivers. Woorora name = *angurun*.

Lysiphyllum cunninghamii (Benth.) de Wit AVM 79, 185.

Tree to 5 m, sterile, no pods. Frequent in forest with *Adansonia gregorii* on raised sandbank above river bank and below rugged sandstone boulder-strewn plateau, in brown sand in gorge of Neville Creek and Charnley River.

Senna goniodes (Cunn. ex Benth.) Randell CD s.n.

Shrub to 1 m, flowers yellow. Tributary of left bank of Isdell River, 10 miles from mouth. Fl. Aug.

Senna notabilis (F.Muell.) Randell JJA & GJK 1384.

Shrub to 1 m, leaves compound, furry, spiked at tip, flowers bright golden yellow. Common in savannah woodland with emergent *Eucalyptus miniata* and *Terminalia*. Near sandstone cliffs in red loamy sand near Mt Daglish. Fl. June.

Senna timoriensis (DC.) Irwin & Barneby AVM 65.

Shrub to 2 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, on riverbank in brown sand at edge of rugged sandstone boulder plateau, near junction of Charnley and Calder Rivers.

CAPPARACEAE

Capparis jacobsii Hewson JJA & GJK s.n.

Shrub, in vine thicket, Mt Daglish.

Cleome viscosa L. KFK (SR).

Open much-branched sub-shrub, flowers yellow. At mouth of Isdell River. Fl. Jan.

CARYOPHYLLACEAE

Polycarpaea involucrata F.Muell. KFK 8753.

Herb, flowers white. In crevices of massive King Leopold Sandstone, abutting alluvial floodplain with *Adansonia gregorii*, *Xanthostemon paradoxus*, *Terminalia* sp., *Brachychiton* sp., Calder River. Fl. May.

Polycarpaea longiflora F.Muell. DJE 15, 39.

Woody herb 40 cm, flowers deep red-maroon. Frequent on edge of King Leopold Sandstone slab adjacent to gallery forest in brown clayey sand. Also occurs frequently in woodland on top of rugged boulder-strewn plateau in pale sandy skeletal soil at junction of Charnley and Calder Rivers. Fl. May.

CELASTRACEAE

Cassine melanocarpa (F.Muell.) Kuntze DF 38.

Small tree 5 m. Frequent in forest of rocky gorge over basalt in reddish-brown sandy clay, Harding Range.

Denhamia obscura vel. affin. (A.Rich.) Meissner KFK 10452.

Shrub to 1 m. In vine thicket of Harding Range.

CERATOPHYLLACEAE

Ceratophyllum demersum L. KFK 8768.

Submerged aquatic. In pool on edge of gallery forest with *Marsilea*, in black peat in inundated area of forest fringing an unnamed creek flowing from a sandstone gorge, Calder River.

CHENOPODIACEAE

Suaeda arbusculoides L.S.Smith WVF 1458.

Near mouth of Calder River.

CHOCHLOSPERMACEAE

Cochlospermum fraseri Planchon subsp. *heteronemum* (F.Muell.) Poppendieck KFK (SR).

Small tree to 4 m, flowers bright yellow, fruits green, globular. In sand over sandstone. Woorora name = *galwa* for above ground parts and *yella* for below ground parts.

COMBRETACEAE

Terminalia bursarina F.Muell. DJE 3.

Large tree to 8 m, flowers in spike, small cream. Frequent in woodlands of alluvial floodplain on underlying sandstone in red-brown clayey sand, Calder River. Fl. May.

Terminalia canescens (DC.) Radlk. KFK (SR)

Shrub or small tree to 6 m; mature fruit a nut with a distinct wing. In savannah on alluvial plain. Worora name = *murambee*.

Terminalia ferdinandiana Exell. KFK 8782, 8751.

Tree to 10 m, bark silver-grey, peeling in irregular chunks. On edge of gallery forest, in black peat in inundated area fringing an unnamed creek flowing from a sandstone gorge, Calder River.

Terminalia fitzgeraldii C.Gardn. CAG 1584.

Tree or shrub to 8 m, fruit glabrous, ovoid, usually with a prominent thick beak. In seasonally inundated claypans, Calder River. Fr. Sept.

Terminalia hadleyana W.Fitzg. subsp. *hadleyana* KFK 8724; AVM 206.

Fairly common tree to 5 m, fruits pale yellowish to green and stiffly fleshy with a tough rind. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone 10 m above river level, in pale skeletal sand, Calder River and Mt Daglish. Fr. May.

Terminalia platyphylla F.Muell. KFK 8697.

Tree to 8 m, bark grey-black, slightly fissured, fruits green, with long beak. Host for hemiparasitic *Dendropthoe acacioides*. Common in sand of alluvial floodplain, Calder River. Fr. May.

Terminalia volucris R.Br. ex Benth. AVM 113.

Small tree, frequent in mixed forest. In shady, large boulder-strewn ephemeral watercourse below sandstone scarp over basalt, in brown skeletal soil of narrow gorge, Neville Creek.

CONVOLVULACEAE

Bonamia pannosa (R.Br.) H. Hallier DJE 34, 44.

Woody herb about 30 cm, flowers purple-mauve. Occasional on edge of forest above river floodplain and below a rugged boulder-strewn plateau of King Leopold Sandstone, in pale sandy skeletal soil, Calder and Charnley Rivers. Fl. May.

Cressa cretica L. CD s.n.

Small prostrate herb, flowers white. By billabongs in drying mud, Munja. Fl. Aug.

Ipomoea aquatica Forsk. KFK 8773.

Creeper, flowers pale mauve with deep mauve centre. On edge of a closed forest growing in black peat in inundated area of gallery forest fringing an unnamed creek flowing from a sandstone gorge, Calder River. Fl. May.

Ipomoea eriocarpa R.Br. DJE 35, 46.

Climber, flowers pinky-mauve. Occasional in forest above river floodplain and below a rugged boulder-strewn plateau of King Leopold Sandstone in pale sandy soil, and on wet muddy river bank, Calder and Charnley Rivers. Fl. May.

Jacquemontia paniculata (Burm.f.) H.Hallier AVM 70, 221.

Climbing woody vine to 2 m, flowers with a pale mauve corolla. In open woodland with *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, 10 m above river level, in pale, sandy, skeletal soil, Charnley River. Fl. May.

Merremia gemella (Burm.f.) H.Hallier WVF 1445.

Trailing creeper, flowers sulphur yellow. Mouth of Calder River. Fl. Aug.

Merremia umbellata (L.) H.Hallier subsp. *orientalis* (H.Hallier) Ooststr. KFK 10475.

Twiner to 10 m with copious white exudate, flowers white. In gallery forest S of Mt Daglish by Calder River. Fl. June.

Operculina brownii Ooststr. AVM 179.

Climbing woody herb, fruits deep red oozing nectar-like clear fluid, dries to dehiscent capsule. Occasional in mixed forest patch in valley at base of sandstone scarp, gorge of Neville Creek. Fr. May.

CRASSULACEAE

Kalanchoe crenata (Andrews) Haw. JJA & GJK 1395; AVM 167.

Woody herb 0.4 m, weakly but distinctly succulent. Occasional in mixed forest in shady, ephemeral waterourse strewn with large boulders and below a sandstone scarp over underlying basalt in brown skeletal soil, gorge of Neville Creek and Mt Daglish vine thicket. Fl. June.

CUCURBITACEAE

Citrullus lanatus (Thunb.) Matsumura & Nakai DJE 24.

Prostrate scrambler, leaves deeply lobed, flowers yellow. Occasional on river bank strewn with sandstone boulders in reddish-brown sandy clay, Calder River. Fl. May.

Cucumis melo L. subsp. *agrestis* (Naudin) Grebensc. AVM 18.

Climbing woody herb 0.5 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, on basalt boulder scree slope with brown loam soil, at junction of Brockman and Calder Rivers.

Luffa cylindrica (L.) M.Roemer KFK 8767.

Trailing scrambler, flowers large, yellow. In black peat at edge of gallery forest fringing an unnamed creek flowing from a sandstone gorge, Calder River. Fl. May.

Luffa graveolens Roxb. DJE 23.

Prostrate scrambler, flowers yellow, melons small with papillae. Occasional in woodland by river bank over sandstone in reddish-brown clayey sand, Calder River. Fl. and Fr. May.

Trichosanthes cucumerina L. KFK 8719.

Creeper, flowers white, corolla lobes fringed, fruits green ripening to orange. Growing over massive sandstone rocks in gorge of Charnley River. Fl. and Fr. May.

DILLENIACEAE

Hibbertia oblongata R.Br. ex DC. AVM 215.

Shrub to 2 m. Occasional in open wodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone 10 m above river level in pale, skeletal sand, Charnley River.

DROSERACEAE

Drosera indica L. DD 11.

Herb, flowers bell-shaped, reddish-pink. On rock face in well-watered grey clay over sandstone, in gorge of Charnley River. Fl. May.

Drosera petiolaris R.Br. ex DC. WVF 1441.

Calder River. Fl. Aug.

EBENACEAE

Diospyros ferrea (Willd.) Bakh. var. *humilis* (R.Br.) Bakh. JJA & GJK s.n.; DF 31; KFK 8774.

Tree to 8 m, bark dark grey-brown, smooth, shedding in irregular patches, branchlets grey with numerous raised lenticels. In black peat on edge of gallery forest fringing an unnamed creek flowing from a sandstone gorge, Calder River, occasionally in scrub with *Ficus*, *Strychnos*, *Brachychiton* and *Canarium* in a rocky gorge over sandstone in sandy soil of upper Neville Creek and in Mt. Daglish vine thicket.

Diospyros maritima Blume JJA & GJK 1349; DF 40; AVM 174.

Tree to 7 m, fruits pale green, turning a pale yellow when ripe. Common in mixed forest in shady ephemeral watercourse strewn with large boulders and below a sandstone scarp over underlying basalt in brown skeletal soil of Harding Range, Neville Creek and mouth of Isdell River. Fr. May.

EUPHORBIACEAE

Antidesma ghaesembilla Gaertner WRE 745; DF 19; BH 25527 RFK; KFK 8754, 8780.

Tree to 7 m, bark grey-brown, slightly papery and flaky, fruits purple. With *Eucalyptus houseana* and *Ficus* on edge of gallery forest fringing an unnamed creek flowing from a sandstone gorge of Calder River, and mouth of Isdell River. Fr. May.

Bridelia tomentosa Blume AVM s.n.

On sandstone above Charnley River.

Croton tomentellus F.Muell. AVM s.n.; DF 32.

Small tree to 3 m, bark grey with white blotches and vertical white cracks, and numerous lenticels horizontaly arranged on branches. Occasional in scrub with *Ficus*, *Brachychiton*, *Strychnos*, *Tabernaemontana* and *Canarium* in a rocky gorge beside running water over sandstone in sand, upper Neville Creek and Charnley River.

Euphorbia atoto G.Forster AVM 207.

Shrub to 1 m. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone 10 m above river level in pale, skeletal sand, Charnley River.

**Euphorbia hirta* L. JJA & GJK 1333; KFK 8713.

Spreading herb, upper leaves with purple blotches, lower leaves light green. In alluvial sand, Calder River and at mouth of Isdell River. Fl. June.

Euphorbia tannensis Sprengel AVM 199.

Shrub to 1 m. In open woodland of *Adansonia gregorii* and other species over open spinifex in rough-and-tumble boulder plateau of King Leopold Sandstone 10 m above river level in pale, skeletal sand, Charnley River.

Excoecaria agallocha L. KFK (SR).

Mangrove on narrow levee banks abutting steep sandstone cliffs at mouth of Charnley River.

Flueggea virosa (Roxb. ex Willd.) Voigt subsp. *melanthesoides* (F.Muell.) Webster CD s.n.; AVM 27, 83.

Shrub to 2 m, mature fruit white. Occasional in forest with *Adansonia gregorii* and other mixed species, on basalt boulder scree slope with brown loam soil, on raised sandbank above river bank and below rugged sandstone boulder-strewn plateau, Charnley River, foothills of Harding Range and junction of Brockman and Calder Rivers. Fr. May.

Glochidion sumatranum Miq. DF 22; BH 25144 RFK; KFK 8765, 8771, 10478.

Tree to 20 m, roots slightly buttressed, bark grey-black and stringy with fibrous blaze, peeling in large flakes, the ends curling up, leaves dark glossy green above, paler beneath, ripe fruits pale yellow-green. One of the main canopy trees on edge of gallery forest fringing creek flowing from King Leopold Sandstone gorge, in black peaty soil, with *Ficus*, *Syzygium* and *Flagellaria*, Calder River. Fr. May.

Mallotus nesophilus Muell.Arg. BH 25528 RFK; AVM 71, 81.

Tree to 6 m. In forest of *Adansonia gregorii* and other species on sandy levee bank of river at edge of small patch of monsoon forest and vine thicket at base of abrupt 10 m high plateau of King Leopold Sandstone. Ripe orange fruits eaten by Great Bower Bird (*Ptilonorhynchus nuchalis*). Charnley River, and mouth of Isdell River. Fr. May.

Omalanthus novo-guineensis (Warb.) Lauterb. & Schumann JJA & GJK 1337; AVM s.n.

Erect leafy shrubs or small trees to 4 m, flowers creamy green on long spike. In forest near Charnley River and at mouth of Isdell River. Fl. June.

Phyllanthus maderaspatensis L. KFK 8712; AVM 202.

Sub-shrub 1-2 m. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold

Sandstone 10 m above river level in pale, skeletal sand, Charnley and Calder Rivers.

Phyllanthus reticulatus Poiret BH 13560, 21211 V; KFK 10461, 10468.

Vine to 10 m. Mouth of Isdell River.

Phyllanthus trachygyne Benth. AVM 3.

Woody herb 0.5 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, on basalt boulder scree slope with brown loam soil, junction of Brockman and Calder Rivers.

GENTIANACEAE

Canscora diffusa (Vahl) R.Br. ex Roemer & Schultes JJA & GJK 1389.

Fine herbs to 20 cm, leaves fine and opposite, flowers pink. Common in loam pockets in sandstone rubble of creek-bed in valley by Mt Daglish. Fl. June.

GOODENIACEAE

Goodenia sepalosa F.Muell. ex Benth. var. *glandulosa* Carolin CAG 1586.

In seed. Fr. Sept.

GYROCARPACEAE

Gyrocarpus americanus Jacq. DF 35; AVM 165.

Tree to 4 m, bark greeny-grey, fleshy, leaves light green, bunched at ends of branchlets. In forest in shady, ephemeral watercourse strewn with large boulders and below a sandstone scarp over underlying basalt, in brown skeletal soil, with *Ficus*, *Strychnos*, and *Canarium*, gorge of Neville Creek and mouth of Isdell River.

LAMIACEAE

Anisomeles malabaricum (L.) R.Br. ex Sims DJE 40; AVM 205.

Woody shrub to 1 m, flowers, tiny, mauve. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, 10 m above river level, in pale, skeletal sand, Charnley River. Fl. May.

Solenostemon scutellarioides (L.) Codd DD 8.

A highly aromatic herb of 60 cm with mauve-blue flowers, on rock face in well-watered grey soil. Charnley River gorge. Fl. May.

LAURACEAE

Cassytha filiformis L. WVF 1453.

Mouth of Calder River.

Cryptocarya cunninghamii Meissner BH 13258.

Tree to 15 m. In vine thicket of Harding Range. Fr. June.

LECYTHIDACEAE

Planchonia careya (F.Muell.) R.Knuth DF 1, 34.

Tree to 6 m, grey-black bark, deeply fissured, 2 cm thick, with vertical cracks, inner bark deep red, sapwood white. In scrub with *Ficus opposita*, *Strychnos* and scattered boabs, on flat open grassland on alluvial plain which is sandstone-basalt derived in brown sandy clay, upper Neville Creek and Munja.

LOGANIACEAE

Mitrasacme galbina Dunlop (in edit) CD s.n.

Herb. Surrounding permanent spring between mouths of Charnley and Calder Rivers. Fl. Aug.

Mitrasacme hispida W. Fitzg. DJE 10.

Woody herb to 0.5 m, flowers, small, white. Occasional in gallery forest at edge of inundated area, below King Leopold Sandstone slab in black peaty soil, Calder River. Fl. May.

Strychnos lucida R.Br. AVM 1; DF 30.

Shrub to 2 m, ripe fruits orange but most fruits still green. Occasional in scrub or woodland with *Adansonia gregorii*, *Ficus*, *Canarium* and *Brachychiton*, in a rocky gorge over sandstone in sand and on basalt boulder scree slope with brown loam soil, upper Neville Creek and junction of Brockman and Calder Rivers. Fr. May.

LORANTHACEAE

Amyema villiflorum (Domin) Barlow AVM 76.

Hemiparasite on *Lysiphyllum cunninghamii*. Occasional in forest with *Adansonia gregorii*, on raised sandbank above riverbank and below rugged boulder-strewn sandstone plateau, Charnley River.

Decaisnina biangulata (W.Fitzg.) Barlow KFK 8695.

Pendulous hemi-parasite, stems angular, flowers tube orange-red for half distance from base, becoming green then tipped maroon-black, recurved perianth segments green occasionally with reddish tinge where they reflex. On *Syzygium eucalyptoides* at edge of Calder River on alluvial floodplain. Fl. May.

Dendrophthoe acacioides (Benth.) Tieghem var. *acacioides* KFK 8696.

Hemi-parasite on *Terminalia platyphylla*, leaves glaucous, flowers pale salmon-pink, connective directly below anther crimson red, not extending into corolla tube, anthers yellow, also style. Common with *Decaisnina biangulata*, Calder River. Fl. May.

LYTHRACEAE

Lagerstroemia archeriana Bailey KFK 8720.

Small tree to 4 m. Amongst massive sandstone scree below gorge, Charnley River.

MALVACEAE

Abutilon andrewsianum W.Fitzg. DJE 4; DF 4.

Small shrub to 1.5 m, leaves dark green above and whitish beneath, densely pubescent above and below, petiole 4-7 cm long and hairy, flowers yellow-orange. Occasional in woodland and grassland of alluvial floodplain in brown-black sandy clay, Munja and Calder River. Fl. May.

Abutilon indicum (L.) Sweet JJA & GJK s.n.; AVM s.n.

On sandstone, Charnley River and Mt Daglish vine thicket.

Hibiscus fryxellii Mabb. KFK 8750.

Sub-shrub to 0.5 m, flowers pink. On edge of King Leopold Sandstone adjacent to a closed gallery forest, Calder River. Worora name = *djurad*. Fl. May.

Hibiscus leptocladus Benth. AVM 201.

Sub-shrub to 1 m. Occasional in open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, 10 m above river level, Charnley River.

Hibiscus meraukensis Hochr. DF 7.

Dwarf shrub 1 m, leaves dark green above and paler beneath. Occasional in woodland of alluvial floodplain in red-brown sand, Munja.

Thespesia thespesioides (Benth.) Fryxell KFK 8749, 10459.

Shrub to 1.5 m, flowers orange. In transitional area between massive outcropping of King Leopold Sandstone and *Eucalyptus houseana* woodland fringing a closed gallery forest, Calder River and mouth of Isdell River. Fl. May.

MELASTOMATACEAE

Melastoma affine D. Don KFK (SR).

Tall shrub to 2 m, flowers pinkish purple. On edge of patch vine thicket on Isdell River.

Memecylon pauciflorum Blume var. *pauciflorum* JJA & GJK s.n.; DF 33.

Small tree to 4 m, bark finely vertically fissured, inner bark brown-fawn, unripe fruits green. Occasional in scrub with *Ficus*, *Brachychiton* and *Strychnos* in rocky gorge by running water over sandstone on sandy soil, upper Neville Creek and Mt Daglish vine thicket. Fr. May.

MELIACEAE

Aglaia elaeagnoidea (A.L.Juss.) Benth. AVM 102.

Sub-emergent tree, leaflets alternate. In forest of mixed species on a large boulder-strewn ephemeral shady watercourse below a sandstone scarp of basalt in narrow gorge, Neville Creek.

Melia azedarach L. var. *australasica* (A.L.Juss.) C.DC. JJA & GJK 1326, 1382; DF 5; BH 25141 RFK, 25535 RFK; KFK 8778, 10450A.

Tree to 8 m, leaves bipinnate, dark green above, light green beneath. Occasional in grassland of alluvial floodlain in black-brown sandy clay, and in black peat in inundated area of gallery forest fringing an unnamed creek flowing from a sandstone gorge, Calder River, Munja, Mt Daglish and mouth of Isdell River. Fr. June.

Owenia vernicosa F.Muell. AVM 226.

Low tree to 4 m, fruits green. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, 10 m above level of river in pale sandy, skeletal soil, Charnley River. Fr. May.

Xylocarpus moluccensis (Lam.) M.Roemer AVM 64.

Tree 7 m. Occasional in woodland of mixed mangroves in a small ditch of creek at edge of rugged boulder plateau of sandstone, in grey sandy clay, Charnley River.

MENISPERMACEAE

Pachygone ovata Miers ex J.D.Hooker & Thomson AVM 154, 194.

Climbing woody herb 2-4 m. Occasional in mixed monsoon forest in narrow gorge, in red-brown loam, at base of sandstone scarp and in boulder-strewn watercourses over basalt, Neville Creek.

Tinospora smilacina Benth. AVM 58, s.n.

Climbing woody herb to 2 m. Occasional in woodland with *Adansonia gregorii* and other mixed species on basalt boulder scree slope with brown loam soil and in forest above Charnley and Calder Rivers.

MIMOSACEAE

Acacia arida Benth. AVM s.n.

On sandstone, Charnley River.

Acacia delibrata Cunn. ex Benth. AVM 195.

Occasional shrub in open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble King Leopold Sandstone plateau, 10 m above level of river in pale, sandy, skeletal soil, Charnley River.

Acacia froggattii Maiden CD s.n.

Spreading, viscid, aromatic sub-shrub to 0.7 m high, flowers yellow, growing in sandstone. Artesian Range between Charnley River gorge and head of Walcott Inlet. Fl Aug.

Acacia hemsleyi Maiden AVM 67.

Shrub to 3 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, on river bank in brown sand at edge of rugged sandstone boulder plateau, Charnley River.

Acacia platycarpa F.Muell. AVM s.n.

Small erect tree, bark dark grey, flakey to fibrous, reddish-brown below surface, upper branches smooth, highly pruinose, branchlets orange-yellow, flowers white. In closed forest at edge of Charnley River. Fl. May.

Acacia stigmatophylla Cunn. ex Benth. AVM 11; DJE 1.

Shrub to 1 m. Occasional in woodland with *Adansonia gregorii* and other mixed species on a basalt boulder scree in brown loamy soil, also frequent in alluvial floodplain woodland, Calder River. Fl. May.

Acacia tenuispica Maslin AVM 224.

Shrub to 2 m. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone 10 m above level of river in pale, sandy, skeletal soil, Charnley River.

Albizia lebbeck (L.) Benth. AVM 77, 187, 190; DF 37.

Large tree to 10 m, bark corky, widely fissured. Occasional in forest associated with *Lophostemon grandiflorus* in ephemeral watercourse, also in forest with *Adansonia gregorii* and other mixed species on raised sandbank above floodplain, and below a rugged sandstone boulder plateau, in brown sand, gorges of Neville Creek and Charnley River.

MORACEAE

Fatoua pilosa Gaud. AVM 22.

Woody herb to 0.2 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, also on basalt boulder scree slope with brown loam soil, junction of Brockman and Calder Rivers.

Ficus coronulata F.Muell. KFK 8698.

Tree to 7 m, bark smooth, light grey, leaves discolorous, dark green on top, light green underneath. Common beside river in alluvial sand, Calder River.

Ficus hispida L.f. JJA & GJK 1347; DF 13; BH 25521 RFK; KFK 10460.

Tree 12 m. In the deposition zone at junction of sandstone outcrop and alluvial floodplain, water-logged and spring-fed, and in black peaty soil, with *Ficus, Pandanus, Melaleuca leucadendra* and *Eucalyptus houseana*, Calder River, and mouth of Isdell River.

Ficus leucotricha (Miq.) Miq. AVM 115.

Small tree, large ripe figs on ground. Occasional in mixed forest, in brown skeletal soil, in shady, large boulder-strewn ephemeral watercourse below sandstone scarp, over basalt, in narrow gorge of Neville Creek. Fr. May.

Ficus opposita Miq. JJA & GJK 1327; DF 2.

Tree 5 m, leaves dark green above, paler beneath, sandpapery rough with three prominent basal veins and milky sap, fruit globular, 1 cm diameter, purple-black when ripe, fruit stalk 5-7 mm. Frequent in low open woodland of alluvial floodplain, with scattered *Adansonia* and *Terminalia* in brown-black sandy clay, Munja, and common on edge of *Nauclea orientalis* forest-riverine flat in inundated black clay at mouth of Isdell River.

Ficus opposita var. *indecora* (Miq.) Corner CD s.n.

Tree 5 m. Munja.

Ficus platypoda (Miq.) Cunn. ex Miq. DF 27; BH 13561, 25520 RFK.

Well-spread small tree 2 m, bark greyish-white, end of branchlets densely pubescent, leaf undersurface finely pubescent. With *Canarium* and *Celtis*, straggling on craggy sandstone at head of gorge, Neville Creek, and mouth of Isdell River.

Ficus racemosa L. JJA & GJK 1322; DF 11; KFK 8740.

Large cauliferous tree to 15 m, bark white-grey, scaly and shedding in square patches, roots buttressed. Dominant to abundant with *Flagellaria* and *Ficus*, in forest bordered by *Melaleuca leucadendra* and *Eucalyptus houseana*. In deposition zone fed by springs, surface and sub-surface, run-off at base of junction between sandstone outcrop and alluvial plain in black peaty sand, Calder River and mouth of Isdell River. Worora name = *killiam*.

Ficus scobina Benth. vel. affin. BH 13559.

Tree to 5 m, leaves scabrous. Mouth of Isdell River.

Ficus tinctoria G. Forster AVM 170.

Climbing woody herb. Occasional in mixed forest in shady, ephemeral watercourse strewn with large boulders and below a sandstone scarp over underlying basalt in brown skeletal soil in gorge of Neville Creek.

Ficus virens Aiton var. *sublanceolata* (Miq.) Corner DF 10; KFK 10457; AVM 145.

Tree to 10 m, bark white-grey, fruits cream coloured (being eaten by Varied Triller). Frequent in gallery forest with *Ficus*, *Pandanus*, *Flagellaria* and *Lophostemon*, in deposition zone fed by surface and sub-surface springs and run-off at base of sandstone outcrop in transition to alluvial floodplain, over sandstone in black peaty soil, Calder River and mouth of Isdell River. Fr. May.

MYRSINACEAE

Rapanea porosa (F.Muell.) Mez JJA & GJK 1381; AVM 161.

Small tree 3-4 m, fruits, pale green, perhaps not ripe. Occasional in mixed forest in a shady, ephemeral watercourse strewn with large boulders and below a sandstone scarp over underlying basalt in brown skeletal soil in gorge of Neville Creek and Mt Daglish vine thicket. Fr. May, June.

MYRTACEAE

Calytrix brownii (Schauer) Craven JJA 559; AVM 40.

Dwarf shrub 1 m. Occasional in woodland with *Adansonia gregorii* and other mixed species on basalt boulder scree slope with brown loam soil, Calder River, and near Mt Daglish vine thicket.

Calytrix exstipulata DC. DD 10; CD s.n.; DJE 13; DF 22.

Shrub to 2 m, leaves weakly scented, corolla tube green, sepals crimson. Occasional in dry open woodland on sandstone plateau with yellow sand of Harding Range, on rock face in well-watered soil of grey sandy clay of gorge in Charnley River, in grassland on edge of sandstone slab in reddish-brown sandy clay near gallery forest, Calder River, and in limestone gorge of Isdell River.

Eucalyptus brachyandra F. Muell. WRE 810.

Tree to 4 m, bark fibrous. In sandstone along Calder River.

Eucalypyus clavigera Cunn. ex Schauer CAG 1088.

Erect tree to 10 m, flowers white. Walcott Inlet. Fl. Sept.

Eucalyptus confertiflora F.Muell. CAG 268, 1088, 1588.

Tree with stocking bark, flowers white. Charnley River. Fl. Sept.

Eucalyptus houseana W. Fitzg. ex Maiden BH 25525 RFK; KFK 10449.

Tree to 25 m, bark smooth, white, leave pale green. In gallery forest E end of Inlet.

Eucalyptus polycarpa F. Muell. KFK (SR).

Tree, on edge of gallery forest near Charnley River.

Eucalyptus tectifica F.Muell. CAG 1589; AVM 52.

Tree 10 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, on basalt scree slope with brown loam soil, Calder River. Worora name = *golyu*.

Lophostemon grandiflorus (Benth.) Peter G. Wilson & J.T. Waterhouse subsp. *riparius* (Domin) Peter G. Wilson & J.T. Waterhouse. KFK (SR).

Large tree, on alluvial floodplain on edge of Calder River.

Melaleuca leucadendra (L.) L. DF 20; BH 25524 RFK, 25534 RFK; KFK 10786, 10798.

Tree 8 m. Abundant at edge of gallery forest with *Eucalyptus houseana* and *Pandanus spiralis* on edge of alluvial plain on edge of sandstone outcrop in black peaty sand, Calder River, and mouth of Isdell River.

Melaleuca viridiflora Sol ex Gaertner BH 25522 RFK, 25523 RFK; KFK 10784, 10785, 10790.

Paperbark to 12 m, "narrow-leaved". On edge of gallery forest, mouth of Isdell River.

Syzygium eucalyptoides (F.Muell.) B.Hyland WVF s.n.

Tree in bud and flower. Calder River. Fl. Aug.

Syzygium nervosum DC. JJA s.n.; BH 25143 RFK; KFK 8744, 8760, 8769, 10479, 10906.

Slightly buttressed tree to 15 m, bark grey-brown, shedding in irregular flakes, blaze cream fibrous, leaves glossy green, young leaves with a purple flush. Forming canopy in gallery forest, in black peat soil, Calder River, mouth of Isdell River and Harding Range.

Syzygium suborbiculare (Benth.) T.Hartley & Perry KFK 8742.

Tree to 5 m, bark light silver-grey. On edge of wetland at junction of sandstone and floodplain, Calder River.

Xanthostemon eucalyptoides F.Muell. BH 25532 RFK.

Spreading tree to 4 m, leaves sessile. In sandstone water courses.

Xanthostemon paradoxus F.Muell. JJA & GJK 1393; AVM 203.

Low tree to 4 m, flowers rich yellow. Fairly frequent in open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, 10 m above level of river, in pale, sandy, skeletal soil, Calder River, and edge of Mt Daglish vine thicket. Fl. May.

NYCTAGINACEAE

Boerhavia burbidgeana Hewson KFK 8711.

Tuberous sub-shrub, flowers pink. In alluvial sand, Calder River. Fl. May.

Boerhavia dominii Meikle & H.J.Hewson JJA & GJK 1348; AVM s.n..

Erect herb to 30 cm, flowers mauve. Uncommon in *Nauclea orientalis* forest-riverine flat in inundated black clayey soil, mouth of Isdell and Charnley Rivers. Fl. May.

Pisonia aculeata L. BH 21214 V.

Liane, flowers small and inconspicuous. In vine thicket, SW end of Harding Range.

NYMPHAEACEAE

Nymphaea violacea Lehm. Hook. KFK 8722.

Emergent aquatic, flowers blue-mauve, calyx segments mottled deep purple. Common in billabong behind abandoned Munja Station. Fl. May.

OLEACEAE

Jasminum didymum G.Forster AVM 7, 55, 212.

Woody scrambler or vine to 2 m, flowers cream. Occasional in woodland with *Adansonia gregorii* and other mixed species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, 10 m above level of river, in pale skeletal sand or brown loam, Calder River. Fl. May.

Jasminum didymum G.Forster subsp. *didymum* (approaching subsp. *lineare* (R.Br.) P.S.Green). AVM s.n.

On sandstone, Charnley River.

Jasminum molle R.Br. AVM 63.

Shrub 0.5-1 m, ripe fruit shiny black. Occasional in woodland with *Adansonia gregorii* and other mixed species on brown sandy river bank at edge of rugged sandstone boulder plateau, Charnley River. Fr. May.

ONAGRACEAE

Ludwigia octovalvis (Jacq.) Raven JJA & GJK 1346.

Erect leafless herb to 50 cm, pods ribbed, brown. Rare in *Nauclea orientalis* forest-riverine flat in inundated black clayey soil at mouth of Isdell River. Fr. June.

Ludwigia perennis L. JJA & GJK 1342; DJE 21; KFK 8731.

Small herb to 20 cm, flowers small, yellow. Occasional in grassy woodland near creek in Warton sandstone in reddish-brown sandy clay and on edge of billabong which abuts King Leopold Sandstone with *Adansonia gregorii* and *Terminalia canescens*, Calder River and at mouth of Isdell River. Fl. May, June.

OPILIACEAE

Cansjera leptostachya Benth. KFK 10471.

Munch-branched shrub to 2 m, branches pendulous, upper leaves glossy green. Near mouth of Isdell River.

Opilia amentacea Roxb. CD s.n.

Woody, semi-erect climber. Beside creek in gully in low grade river forest, foothills of Harding Range.

PAPILIONACEAE

Abrus precatorius L. AVM 9.

Scrambling vine. In woodland with *Adansonia gregorii* and other mixed species on basalt boulder scree slope with brown loam soil, Calder River.

Bossiaea bossiaeoides (Cunn. ex Benth.) Court DF 26.

Dwarf shrub 1 m, well-spreading in form. Occasional in shrubland-heath on a sandstone plateau with yellow sand, Harding Range.

Cajanus acutifolius (F.Muell.) Maesen KFK 8715; AVM 211.

Shrub to 1.5 m, flowers with yellow stamens and maroon striations, keel yellowish green. Forming dense stands in alluvial sand, and occasional plants in open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, 10 m above level of Charnley and Calder Rivers. Fl. May.

Cajanus viscidus Maesen AVM 68.

Shrub of 1 m. Occasional in forest with *Adansonia gregorii* mixed with other species, on brown sandbank at edge of river, below rugged sandstone boulder plateau, Charnley River.

Canavalia papuana Merr. & Perry JJA & GJK s.n.

Climber in Mt. Daglish vine thicket.

Canavalia rosea (Swartz.) DC. CD s.n.

Creeper on river flats, Munja.

Christia australasica (F.Muell. ex Schindl.) Bakh.f. ex Meeuwen AVM 8.

Delicate climber 1-2 m. Occasional in mixed woodland with *Adansonia gregorii*, on a boulder scree slope over basalt, in brown loam, Calder River.

**Clitoria ternatea* L. DJE 48.

Prostrate scrambler, flowers large, bright blue. Above wet muddy river bank near abandoned Munja Settlement. Fl. May.

Crotalaria novae-hollandiae DC. DD 5.

Shrub 70 cm, flowers yellow, pods pea-like. Occasional on steep north-facing slope of King Leopold Sandstone on brown sand, Charnley River. Fl. May.

Crotalaria retusa L. DD 2; DF 6.

Dwarf shrub to 1 m, leaves dark green above, paler beneath and finely pubescent, flowers yellow or purple. Occasional in grassland of alluvial floodplain with brown-black sandy clay soil, and on a rocky island of King Leopold Sandstone in brown sandy soil, Charnley and Calder Rivers. Fl. May.

Crotalaria medicaginea Lam. DD 3; DJE 29, 31; AVM 89; WMM s.n.

Woody herb to 0.5 cm, flowers yellow. Frequent on edge of forest above river floodplain and below a rugged boulder-strewn plateau of King Leopold Sandstone in light brown sandy soil, Charnley River and on bank of billabong below old Munja Station. Fl. May - June.

Desmodium gangeticum (L.) DC. AVM 16.

Woody herb 0.5 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, on basalt boulder scree slope with brown loam soil, Calder River.

Desmodium heterocarpon (L.) DC. var. *strigosum* Meeuwen DJE 11.

Small woody herb 1 m, flowers small, purple. In gallery forest inundated

area of King Leopold Sandstone slab with black peaty soil, Calder River. Fl. May.

Flemingia lineata (L.) Roxb. JJA & GJK 1379.

Soft herb to shrub to 1 m, pods green. Uncommon in deciduous vine thicket in red loamy soil, Mt Daglish. Fl. & Fr. June.

Glycine tomentella Hayata AVM 5.

Climbing woody herb, 1-1.5 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, on basalt boulder scree slope with brown loam soil, Calder River.

Indigofera colutea (Burm.f.) Merr. DJE 32, 38.

Small herb 10 cm, flowers coral-pink to red or mauve. Occasional between grassland and forest on or above river floodplain below a rugged boulder strewn plateau of King Leopold Sandstone in pale brown sandy soil, Charnley River. Fl. May.

Indigofera linifolia (L.f.) Retz. DJE 6.

Small woody herb 15 cm, flowers very small, red. Abundant in grassy woodland on alluvial floodplain in reddish-brown clayey sand, Calder River. Fl. May.

Jacksonia affin. *thesiodes* (Cunn.) Benth. DF 25.

Woody shrub 2 m, flowers yellow. Occasional in shrubland-heath on sandstone plateau, with yellow sand, Harding Range. Fl. May.

Psoralea badocana (Blanco) Blanco CD s.n.

Shrub, flowers purple. On river flats below Harding Range. Fl. Aug.

Rhynchosia minima (L.) DC. DJE 36; AVM 223.

Trailing vine to 2 m, flowers yellow. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, 10 m above level of river, in pale, sandy, skeletal soil, Charnley River. Fl. May.

Sesbania cannabina (Retz.) Poiret var. *cannabina* DD 4; DJE 41; WVF 1446.

Shrub to 5 m, flowers yellow. On a steep north-facing rocky slope of King Leopold Sandstone, with very little soil, occasional in woodland atop a rugged sandstone boulder-strewn plateau in light brown sandy soil, Charnley River and mouth of Calder River. Fl. May.

Sesbania formosa (F.Muell.) N.Burb. BH 13558, 25519 RFK 25529 RFK.

Large tree, leaves pinnate, flowers large white pea. Mouth of Isdell River.

Vigna lanceolata Benth. var. *latifolia* C.T.White KFK 8783.

Trailing perennial, flowers pale yellow. Common on alluvium of valley floor on levee bank adjacent to Calder River. Fl. May.

PASSIFLORACEAE

Adenia heterophylla (Blume) Koord. subsp. *australis* (DC.) de Wilde WVF 1403; AVM 12, s.n.

Climbing woody herb 1-2 m. Occasional in woodland with *Adansonia gregorii* and other mixed species on basalt boulder scree slope with brown loam soil, Calder River, and on sandstone above Charnley River.

**Passiflora foetida* L. var. *hispida* (DC. ex Triana & Planch.) Killip AVM 73.

Climbing herb 2 m, leaves light bright green. Occasional in forest with *Adansonia gregorii* and other mixed species on raised sandbank above river and below rugged sandstone boulder plateau in brown sand, Charnley River.

PEDALIACEAE

Josephinia eugeniae F. Muell. KFK 10908.

Erect herb, leaves discolorous, palish green, flowers pink. In alluvial sand on edge of gallery forest at mouth of Isdell River. Fl. Jan.

PITTOSPORACEAE

Citriobatus spinescens (F.Muell.) Druce DF 39; AVM 104.

Small tree to 4 m, fruits green turning brown, mature fruit containing seeds in a jam. Occasional in forest in a rocky gorge over basalt with reddish-brown soil of clayey sand, and in mixed forest in a shady ephemeral watercourse strewn with large boulders and below a sandstone scarp over underlying basalt rock on skeletal brown soil in gorge of Neville Creek. Fr. May.

PLUMBAGINACEAE

Plumbago zeylanica L. JJA & GJK 1387; DJE 25.

Shrub 1 m, seed capsules sticky. Occasional at edge of forest on raised sandbank above river floodplain and below rugged boulder-strewn plateau of sandstone, in light brown sand, Charnley River, and Mt Daglish vine thicket. Fr. May, June.

POLYGONACEAE

Polygonum barbatum L. KFK 8746.

Perennial woody herb with white flowers. In creek in black peat soil and in inundated area of gallery forest fringing an unnamed creek flowing from a sandstone gorge of Calder River. Fl. May.

PORTULACACEAE

Portulaca bicolor F.Muell. KFK 8752.

Herb, leaves green, stems pink, flowers pink. In crevices of massive King Leopold Sandstone, abutting alluvial floodplain, with *Adansonia gregorii*, *Xanthostemon paradoxus*, *Terminalia* spp. and *Brachychiton* sp., Calder River. Fl. May.

PROTEACEAE

Grevillea heliosperma R.Br. AVM 214.

Tall shrub to 4 m. Occasional in open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, 10 m above level of river, in pale, sandy, skeletal soil, Charnley River.

Grevillea refracta R.Br. JJA 560.

Erect shrub to 4 m, leaves long, linear, flowers orange and yellw. Common on sandstone plateau with *Grevillea wickhamii*, *Acacia* spp. in reddish brown loamy soil, near Mt Daglish vine thicket. Fl. June.

Grevillea wickhamii Meissner JJA & GJK 1392; DF 24.

Woody shrub 2 m, flowers red. Occasional in shrub-heath of sandstone plateau in yellow sandy soil, Harding Range and near Mt Daglish vine thicket. Fl. May, June.

Stenocarpus cunninghamii R.Br. JJA & GJK 1397; KFK 8726.

Small tree to 6 m, flowers yellow-orange. On edge (rim) of cliff of Mt Daglish and on edge of vine thicket. Fl. May, June.

RHAMNACEAE

Alphitonia excelsa (Fenzl) Reissek ex Benth. KFK (SR).

Tree to 12 m, leaves distinctly discolorous, fruits black. On edge of vine thicket on Isdell River.

RHIZOPHORACEAE

Carallia brachiata (Lour.) Merr. JJA & GJK 1344, 1380; DF 21; KFK 8743, 8762.

Tree to 11 m, bark pale orange-grey, roots very slightly buttressed. In black peat soil in inundated area of gallery forest fringing an unnamed creek flowing from a sandstone gorge near Calder River, mouth of Isdell River and Mt Daglish vine thicket. Fl. June.

RUBIACEAE

Aidia racemosa (Cav.) Tirvengenadum JJA & GJK s.n.; DF 29; AVM 198.

Tree to 6 m, ripe fruit, red. Domatia and interpetiolar stipules present. Frequent in scrub near rocky outcrop in gorge on sandstone with grey-yellow

sand and associated with *Ficus* and *Canarium*, in a small patch of vine thicket along seasonal stream feeding the Charnley River, at base of 10 m abrupt plateau of King Leopold Sandstone, Mt Daglish in Harding Range. Fr. May.

Gardenia megasperma F. Muell. var. *arborea* Ewart & Cookson. JJA & GJK 1394; AVM s.n.

Tree to 6 m, bark yellowish grey. Occassional in savannah woodland on sandstone above Charnley River, and near Mt Daglish vine thicket. Fr. June.

Nauclea orientalis (L.) L. JJA & GJK 1321; DF 15; KFK 8741, 8759.

Tree to 11 m, bark grey and slightly corky. In black peat in inundated area of gallery forest, forming the canopy with *Melaleuca viridiflora*, fringing an unnamed creek flowing from a sandstone gorge, near Calder River, and at mouth of Isdell River.

Pavetta brownii Bremek AVM 191.

Shrub 3 m, leaves yellowing. Occasional in mixed forest at edge of patch of monsoon forest along boulder-strewn watercourse at foot of sandstone scarp over basalt, in red-brown loam of gorge, Neville Creek.

Spermacoce breviflora F. Muell. ex Benth. WVF 1448.

Herb, near mouth of Calder River. Fl. Aug.

Timonius timon (Sprengel) Merr. JJA & GJK 1340; DF 18.

Small tree to 3 m. Occasional in gallery forest with *Ficus*, *Syzygium* and *Flagellaria* on alluvial plain on edge of sandstone outcrop in black peat near Calder River, and at mouth of Isdell River.

RUTACEAE

Glycosmis sapindoides Lindley ex Oliver var. *australiensis* B.C.Stone JJA & GJK 1377; DF 28; AVM 139.

Small tree 3 m, buds green, flowers pale yellow, leaves scented. Occasional in scrub with *Ficus* and *Brachychiton* near sandstone crags at head of gorge of Neville Creek, and in Mt Daglish vine thicket. Fl. May, June..

Micromelum minutum (G.Forster) Wight & Arn. DF 41.

Small tree 3 m. Occasional in forest of basaltic rocky gorge with reddish-brown clayey sand, gorge of Neville Creek.

SANTALACEAE

Exocarpos latifolius R.Br. AVM 98.

Shrub 3 m. Occasional in forest with *Adansonia gregorii* and other mixed species, on raised sandbank above floodplain of river and below rugged sandstone boulder plateau, in brown sand, Charnley River.

Santalum lanceolatum R.Br. AVM 74.

Shrub 3 m. Occasional in forest with *Adansonia gregorii* and other mixed species on raised sandbank above river and below rugged sandstone boulder plateau in brown sand, Charnley River.

SAPINDACEAE

Atalaya hemiglauca (F.Muell.) F.Muell. ex Benth. DF 42; AVM 103.

Tree to 2 m. Frequent in mixed forest of a shady ephemeral watercourse strewn with large boulders and below a sandstone scarp over underlying basalt rock in brown skeletal soil, in gorge of upper Neville Creek.

Distichostemon hispidulus (Endl.) Baillon AVM 213.

Shrub 2 m. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, in pale skeletal sand 10 m above level of Charnley River.

Ganophyllum falcatum Blume AVM 188.

Tree 12 m, one of the sub-emergent trees of the forest, probably evergreen. Occasional in monsoon forest patch at base of sandstone scarp and along ephemeral watercourse over basalt rock in with red-brown skeletal soil, gorge of Neville Creek.

SAPOTACEAE

Mimusops elengi L. DF 8; KFK 8756; AVM 72.

Tree to 5 m, milky sap in petiole, numerous raised lenticels, fruit dark orange, ripe, edible, shiny dark pip. Frequent in gallery forest by broad drainage line at base of sandstone, also occasional in forest with *Adansonia gregorii* and other mixed species at the creek edge below a sandstone cliff of rugged boulder plateau near the river bank in brown sand, also black peaty sand of Charnley and Calder Rivers. Fr. May.

Pouteria arnhemica (F.Muell. ex Benth.) Baehni AVM 59; KFK 8723.

Tree to 8 m, bark dark. On Mt Daglish amongst massive Warton Sandstone and in woodland with *Adansonia gregorii* amongst rugged sandstone boulders, in yellow sand, Charnley River.

Pouteria sericea (Aiton) Baehni KFK 8776; AVM 43, 114.

Tree to 6 m, bark dark brown-black. Fruits eaten by Bower Bird. Occasional in woodland with *Adansonia gregorii* and other mixed species on basalt boulder scree slope in brown loam soil, and on edge of gallery forest growing in black peat in inundated area of forest fringing an unnamed creek flowing from a sandstone gorge, Calder River and Mt Daglish vine thicket.

SCROPHULARIACEAE

Limnophila fragrans (G.Forster) Seeman KFK 8766.

Decumbent herb, flower corolla lobes pale mauve, throat white. In mud on

edge of closed gallery forest fringing an unnamed creek flowing from a sandstone gorge, Calder River. Fl. May.

Stemodia affin. *flaccida* W.Fitzg. DD 1; KFK 8718.

Dense, prostrate, woody shrub to 30 cm, leaves pale green, corolla mauve-purple with purple striations. Called 'wild tobacco' by local natives, in Worora = *kolola*, has a very strong characteristic aroma. Common in shallow sand and crevices of shaded King Leopold Sandstone ledges, gorge of Charnley River. Fl. May.

Stemodia lythrifolia F.Muell. ex Benth. AVM 209.

Woody herb to 50 cm. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, 10 m above level of river, in pale skeletal sand, Charnley River.

Striga curviflora (R.Br.) Benth. DJE 16.

Herb to 20 cm, flowers white. Frequent on edge of woodland by a slab of King Leopold Sandstone, Calder River. Fl. May.

SOLANACEAE

**Physalis minima* L. JJA & GJK 1324; KFK 8702.

Sub-shrub to 0.4 m, flowers cream. In alluvial sand beside Neville Creek, and at mouth of Isdell River. Fl. May, June.

Solanum lucani F.Muell. JJA 556; KFK 8721; AVM 210.

Sprawling sub-shrub to 50 cm, flowers blue-mauve. In crevices of massive sandstone in gorge, and in open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and- tumble boulder plateau of King Leopold Sandstone, 10 m above level of river in pale sandy skeletal soil, Charnley River and Mt Daglish vine thicket. Fl. May. Fr. June.

STERCULIACEAE

Brachychiton diversifolius R.Br. KFK (SR).

Tree, on banks of Calder River.

Brachychiton viridiflorus (W.Fitzg.) Guymer AVM 45.

Tree 2-4 m. Occasional in woodland with *Adansonia gregorii* and other mixed species, on basalt boulder scree slope in brown loamy soil, Calder River.

Brachychiton viscidulus (W.Fitzg.) Guymer KFK 8758.

Tree to 5 m, flowers pink, base of perianth green, also in bud. In massive outcropping of King Leopold Sandstone, with *Adansonia gregorii*, *Terminalia spp.* and *Xanthostemon paradoxus*, Calder River. Fl. May.

Helicteres rhynchocarpa W.V. Fitzg. AVM 80.

Shrub of 0.5 m, in old fruit, dehisced. Occasional in forest with *Adansonia gregorii* and other mixed species, on raised sandbank above floodplain of river and below rugged sandstone boulder plateau, in brown sand, Charnley River.

**Melochia pyramidata* L. KFK 8710; AVM 21.

Woody sub-shrub 0.5 m, flowers purple-mauve. Occasional in woodland with *Adansonia gregorii* and other mixed species on basalt boulder scree slope in brown loam soil, also in alluvial sand, Calder River. Fl. May.

Sterculia quadrifida R.Br. AVM 225.

Tall shrub, fruits green. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder plateau of King Leopold Sandstone, 10 m above level of river in pale skeletal sand, Charnley River. Fr. May.

Waltheria indica L. JJA & GJK s.n.; DJE 12; AVM 222.

Woody shrub to 1 m, flowers tiny, yellow.. Frequent at edge of gallery forest on sandstone in black peat, and in open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and- tumble boulder plateau of King Leopold Sandstone, 10 m above level of river in pale sandy skeletal soil, Charnley and Calder Rivers and Mt. Daglish vine thicket. Fl. May.

STYLIDIACEAE

Stylidium irriguum W. Fitzg. CD s.n.; DD 9.

Small herb, leaves spathulate in basal tuft, flowers pink. By permanent spring in ranges between mouths of Calder and Charnley Rivers. Fl. May - Aug.

TILIACEAE

Corchorus acutangulus Lam. KFK 8705.

Herb, stem purple tinged, flowers yellow. In alluvial sand, Calder River. Fl. May.

Corchorus leptocarpus (Cunn.) Benth. KFK 10451.

Sub-shrub to 1.5 m, leaves grey. On edge of vine thicket, Harding Range.

Grewia breviflora Benth. BH 25531 RFK.

Deciduous shrub or tree to 8 m, bark greyish-brown, leaves ovate with 3 prominent veins on undersurface, flowers white or creamish, fruits green turning blue-black. On edge of vine thicket, mouth of Isdell River.

Grewia orientalis L. JJA & GJK 1386; BH 21239 V; AVM 94,

Shrub to 4 m, mature fruits green, most fruits old, dried brown and brittle, fruit has meagre but apparently edible pulp. (A tree rat was observed probably feeding on the fruits). Frequent in forest with *Adansonia gregorii* and other mixed species on raised sandbank above the floodplain and below

a rugged sandstone boulder-strewn plateau of Charnley River and in brown sand or skeletal soil in narrow gorge of Neville Creek, NW of Mt Daglish, and mouth of Isdell River. Fr. May, June.

Grewia oxyphylla Burrett DF 16; AVM 101.

Tree 2-3 m. Occasional in gallery forest with *Eucalyptus houseana*, *Melaleuca*, *Ficus*, *Pandanus* and *Flagellaria*, on alluvial plain on edge of King Leopold Sandstone in black peaty sand, Calder River.

Grewia polygama Roxb. WVF 1455.

Much-branched shrub to 1 m, flowers small, white, fruit reddish brown. In sand over limestone, Mt Daglish. Fl. and Fr. Aug.

Triumfetta pentandra A. Rich DJE 17, 33; AVM s.n..

Woody herb 1 m, flowers yellow, seed burr-like. Abundant on raised sandbank above river floodplain and on edge of forest below a rugged, boulder-strewn plateau of King Leopold Sandstone, in light brown sandy skeletal soil, Charnley River and at edge of gallery forest by Calder River. Fl. and Fr. May.

Triumfetta plumigera F. Muell. AVM 204.

Shrub to 1 m. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder-strewn plateau of King Leopold Sandstone, 10 m above level of river in pale sandy skeletal soil, Charnley River.

Triumfetta sp. F Kimb. Flora AVM 200.

Shrub to 1 m. In open woodland of *Adansonia gregorii* and other species over open spinifex on rough-and-tumble boulder-strewn plateau of King Leopold Sandstone, 10 m above level of river in pale sandy skeletal soil, Charnley River.

Triumfetta sp. M Kimb. Flora KFK 10911.

Sub-shrub, flowers yellow. In alluvial sand on edge of gallery forest at mouth of Isdell River. Fl. Jan.

Triumfetta sp. S Kimb. Flora KFK 11149

Shrub to 1 m, flowers yellow. Amongst sandstone outcrop at mouth of Isdell River.

ULMACEAE

Celtis philippensis Blanco DF 9; KFK 8775.

Tree to 8 m, bark silver-grey. On edge of gallery forest fringing an unnamed creek flowing from a sandstone gorge, in black peat soil. Also found frequently in forest with *Ficus* sp., *Pandanus* and *Flagellaria* in alluvial deposition area at base of sandstone outcrop, over sandstone, in black peaty soil, Calder River.

Trema tomentosa (Roxb.) Hara var. *viridis* (Brongn.) Hewson AVM 180.

Shrub 2-3 m, ripe fruit small, black shiny. Occasional in mixed forest patch in valley at foot of sandstone scarp over basalt in red-brown loam, gorge of Neville Creek. Fr. May.

VERBENACEAE

Callicarpa candicans (Burm.f.) Hochr. JJA & GJK 1384; AVM 116, 164.

Shrub 1-2 m, fruits small, dull, purple when ripe. Occasional in mixed forest in brown skeletal soil in narrow gorge strewn with large boulders, and frequent in mixed forest of shady, large boulder-strewn ephemeral watercourse below sandstone scarp over basalt, in gorge of Neville Creek, and common in deciduous vine thicket by Mt Daglish. Fr. May, June.

Clerodendrum tomentosum (Vent.) R.Br. var. *lanceolatum* (F. Muell.) Munir WRE 1006.

Small tree. Walcott Inlet. Fl. Sept.

Premna acuminata R.Br. KFK 10458; AVM 90.

Shrub 2 m. Occasional in forest with *Adansonia gregorii* and other mixed species on raised sandbank above floodplain of river and below rugged sandstone boulder plateau in brown sand, Charnley River, and mouth of Isdell River and in Mt. Daglish vine thicket.

Vitex acuminata R. Br. JJA s.n.

Small tree in Mt. Daglish vine thicket.

VIOLACEAE

Hybanthus aurantiacus (F.Muell. ex Benth.) F.Muell. DD 12; DJE 45, 49; KFK 8714.

Woody herb to 40 cm, flowers yellow. In alluvial sand on wet river bank, and on rocky sandstone cliff in grey sand, Calder and Charnley Rivers. Fl. May.

Hybanthus enneaspermus (L.) F.Muell. DJE 47.

Small herb above flooded bank, Calder River. Fl. May.

VITACEAE

Ampelocissus acetosa (F. Muell) Planchon KFK (SR); AVM 48.

Scrambling vine, flowers deep maroon with darker centre, fruits green turning purple black. In vine thicket at mouth of Isdell River. Fl. May.

Cayratia trifolia (L.) Domin BH 21212 V; KFK 10462.

Tendril climber to 20 m. In vine thicket at mouth of Isdell River.

Cissus adnata (Wallich) Roxb. AVM 69.

Climbing shrub or woody herb to 1 m, ripe fruits shiny dark purple-black. Occasional in woodland with *Adansonia gregorii* and other mixed species on a rugged boulder plateau of sandstone near river, in yellow sand, Charnley River, and on boulder scree slope over basalt in brown loam, Calder River. Fr. May.

Key to collectors and symbols used.

JJA	Jenny Alford
DD	David Dale
CD	Consett Davis
DJE	D.J.Edinger
WRE	W.R.Easton
DF	David Fell
WVF	W.V.Fitzgerald
CAG	C.A.Gardner
BH	Bernie Hyland (V = vine, RFK = Rainforest Key)
GJK	Greg Keighery
KFK	K.F.Kenneally
JRBL	J.R.B.Love
AVM	A.V.Milewski
WMM	W. M. Molyneux
s.n.	No number
(SR)	Sight Record

MAMMALS OF THE MUNJA-WALCOTT INLET AREA WEST KIMBERLEY, WESTERN AUSTRALIA

By ANDREW CHAPMAN Department of Conservation and Land Management, PO Box 366, KALGOORLIE 6430

INTRODUCTION

Between 1-27 May 1983 I recorded data on species of mammals present, their abundance and habitats occupied in the Munja-Walcott Inlet area, while participating in the 1983 Australian and New Zealand Scientific Exploration Society (ANZSES) Kimberley Expedition. Data were recorded from sites chosen to represent the main geological/vegetation/landform types of this area. Mammals were observed with head torches and a 12 volt 100 watt portable spotlight. Trapping was restricted by the necessity to back pack all equipment, however traplines of 10 of each of 'Shermann' box traps and 'Fourways' breakback, traps were run for 4-5 days periods in most habitats. Cage traps were also set at these sites.

Trapping sites and effort are described below. A mixture of peanut paste and rolled oats were used for bait. K.F. Kenneally collected bats at the base campsite and some mist-netting was undertaken elsewhere. A small collection of mammal specimens, M17490-99, has been lodged with the Western Australian Museum.

Prior to this expedition there had been no investigation of the mammal fauna of this area nor could I locate any published observations. However since this expedition two sites near the mouth of the Isdell River have been surveyed as part of the Kimberley component of the National Rainforest Programme. At a site numbered 19/2 located at 124° 50' 35"E, 16° 27' 35"S 13 mammal species were recorded (Friend *el al.* 1991). These sites as well as those along the Charnley River reported here are included in the proposed Walcott Inlet National park, (see Burbidge *et al.* 1991).

Vegetation at trapping sites was described following Muir (1977) except for vine thicket descriptions which follow Beard (1976).

Site 1 Located at 124° 59'E, 16° 19' S near base camp in Open Low Woodland A *over* Dense Tall Grass on riverine flood plain. 100 trap nights.

Site 2a Located at 124° 59'E, 16° 23' S on the Charnley River in vine thicket and monsoon forest. 80 trap nights.

Site 2b Located near 124° 59'E, 16° 23' S on the Charnley River in tumbled King Leopold Sandstone with *Triodia* spp. Open Low Woodland A *over* Low Scrub A *over* Mid Dense Hummock Grass. 80 Trap nights.

Site 3a Located at 124° 58'E, 16° 15' S in a ravine in the Harding Range, a vine thicket and monsoon forest. 20 trap nights.

Site 3b Located near 124° 58'E, 16° 15' S in a ravine in the Harding Range, a savannah woodland on valley slopes. Low Woodland A *over* Mid Dense Hummock grass, 20 trap nights.

These sites are indicated in Map 1 in Kenneally and Edinger (this publication).

ANNOTATED LIST

The nomenclature used follows Strahan (1983).

TACHYGLOSSIDAE

Tachyglossus aculeatus - Short-beaked Echidna.

Echidna scats were seen on only one occasion, on Warton Sandstone in the Harding Range. Apparently uncommon.

DASYURIDAE

Dasyurus hallucatus - Northern Quoll

Northern Quoll were caged-trapped repeatedly in vine thicket and King Leopold Sandstone near Charnley Gorge at 16° 24'00"S, 124° 59' 30" E and observed in riverine woodland on basalt in Neville Creek near site 3a. I received several reports of 'spotted, foxy-faced miscreants' raiding food supplies from expedition members. Here, as elsewhere in the Kimberley, this species is relatively abundant and occupies a wide variety of habitats.

PERAMELIDAE

Isoodon auratus - Golden Bandicoot.

A bandicoot observed in a vine thicket adjacent to King Leopold Sandstone near site 2a, was probably this species, although *Isoodon macrourus* cannot be ruled out. Habitat considerations from elsewhere in the Kimberley, eg McKenzie *et al.* (1975) for the Prince Regent Reserve, suggest *I. auratus* the more likely. Both species are present nearby at Wotjuluin (16° 11'S, 123° 37'E), (Kitchener & Vicker 1981). *Isoodon macrourus* was recorded at Isdell River (Friend *et al.* 1991).

PHALANGERIDAE

Wyulda squamicaudata - Scaly-tailed Possum.

A sub-adult female was observed from 2-3 m in a tree in King Leopold Sandstone near Charnley Gorge at 124° 59'E, 16° 24'S The possum apparently disturbed by the spotlight moved to the top of the tree, then launched itself into mid air, landing in a pile of sandstone where it disappeared. This is a rare and little known species and one of the few mammal species endemic in the Kimberley; most Kimberley mammals also occur in Arnhemland or elsewhere in the tropics. Sighting this animal on a hot night, at 2.00 am and showing it to two fellow participants was a highlight of the expedition.

MACROPODIDAE

Petrogale ? brachyotis - Short-eared Rock-wallaby.

Rock wallabies with a dark neck-axillary stripe were frequently seen in King Leopold Sandstone around Charnley Gorge at 124° 59' 30"E, 16° 24' 00"S Also present at site 2b. They were quite abundant at these sites and could readily be seen by day. They occur alongside ? *Peradorcas concinna* (see

below). *Petrogale ? brachyotis* were also present, presumably as an isolated colony, on Warton Sandstone on Mt Daglish. Characteristic scats were recorded on basaltic rocks in the gorge of Neville Creek near 124° 58'E, 16° 15' S.

Peradorcas concinna - Nabarlek

Smaller rock-wallabies were present around Charnley Gorge with *Petrogale ? brachyotis* but not observed during the day. The possibility of these small rock wallabies being *Petrogale burbidgei* can not be overlooked as the habitat here is similar to that where *P. burbidgei* has been recorded further north in the Kimberley. However, *Peradorcas* occurs relatively close (*ca* 150 km) to Charnley Gorge on Long Island in the Buccaneer Archipelago (Mckenzie *et al.* 1978)

Macropus robustus - Common Wallaroo

Wallaroos were presumed to be the large kangaroo reported occasionally to me by members of the expedition. Apparently very scarce, only seen in sandstone country. Sometimes present on Munja Plain according to Wattie Ngerdu. Possibly confused with *Macropus antilopinus.*

PTEROPODIDAE

Macroglussus minimus - Northern Blossom Bat.

One adult female was mist-netted at the same time and place as *Macroderma gigas* (below).

Pteropus alecto - Black Flying-fix.

One female was shot flying over the Calder River near the base camp, savannah woodland was adjacent. A camp of 'some thousands' of flying-foxes was reported to me by expedition participants on the Isdell River at Grid reference 115.574 on the Matthew 1:100,000 sheet. they were in 'riverside trees and pandanus'.

MEGADERMATIDAE

Macroderma gigas - Ghost Bat.

One adult female mist-netted in riverine woodland of *Eucalyptus camaldulensis* and *Erythrophleum sp.* near Charnley Gorge, at 16° 23'S, 124° 58"E.

EMBALLONURIDAE

Taphozous flaviventris - Yellow-bellied Sheathtail Bat.

One of these distinctive bats was observed along the Calder River near base camp, at 16° 19' S 124° 58'E,.

MOLOSSIDAE

Chaerophon jobensis - Northern Mastiff-Bat.

Three were shot on the Calder River near 124° 58"E, 16° 19"S with savannah woodland adjacent.

MURIDAE

Hydromys chrysogaster - Water Rat.

One sub-adult was seen swimming in a pond in Neville Creek near site 3a. This site is well upstream; there were no fish or crustaceans sighted. Frogs and insects were the only readily visible aquatic food source. When disturbed the animal remained submerged under rocks for some 10 minutes.

? Mesembriomys macrurus - Golden-backed Tree Rat.

A large tree-rat, body length *ca* 25 cm, was observed and heard gnawing vines, in a vine thicket near Charnley Gorge at 16° 24' 00"S, 124° 59' 30"E. The only noticeable characteristic was that when viewed from underneath the entire tail was white. Golden-backed Tree Rat was recorded at site 19/2 near the mouth of the Isdell River in the Rainforest Survey (Friend *et al.* 1991).

Zyzomys argurus - Common Rock Rat.

Trapped in King Leopold Sandstone near Charnley Gorge (site 2b), in vine thicket on basalt in Neville Creed (site 3a) and in savannah woodland with Warton Sandstone in Harding Range (site 3b). Three specimens were lodged in the WA Museum, five others were released. This rodent is widespread and common in northern Australia wherever suitable rocky habitat prevails.

Leggadina forresti - Forrest's Mouse.

One was trapped in tall dense grassland on riverine plain (site 1).

CANIDAE

Canis familiaris dingo - Dingo.

Pairs and single animals were seen on several occasions on Munja Plain, along Calder and Isdell Rivers and in Warton Sandstones. Often heard calling at hight from vicinity of Mt Daglish.

FELIDAE

Felis catus - Cat.

One, a tabby, was seen in grassland on Munja Plain.

EQUIDAE

Equus caballus - Horse.

Small groups of 2-3 horses were seen on Munja Plain on several occasions. These are stock horses which are used for annual mustering by the Mowanjum Community.

CAMELIDAE

Camelus dromedarius - One-humped Camel.

Several camel skulls around the site of the former Munja settlement are those of camels which were used to pack equipment from Pantijan to Munja. Live animals were not present.

BOVIDAE

Bos taurus - Cow.

Cattle are now permanent and significant elements of the fauna of Munja Plain. They are subject to an annual dry season muster by the Mowanjum Community Inc. Most cattle were on the rivers and swamps of the plain, however tracks and scats indicate that they do follow creeks up into the Harding Range. At the time of our visit there were probably some 200-300 cattle on Munja Plain.

DISCUSSION

The seventeen native mammal species detected by this expedition certainly do not indicate the probable mammal species-richness of this area. Conversations with Wattie Ngerdu indicate the rollowing readily recognisable species also occur on Munja Plain: *Onchogalea unguifera*, Northern Nailtail Wallaby, *Petaurus breviceps*, Sugar Glider and *Phascogale tapoatafa*, Brush-tailed Phascogale. A greater trapping effort would add several species of small dasyurids and rodents and greater effort in bat collecting would make these results more comparable to those of other Kimberley fauna surveys. For mammal survey work, large numbers of people in the field are no substitute for specialised and intensive collecting techniques, because of the cryptic nature of the Australian mammal fauna. However in spite of this constraint this expedition did have the opportunity to examine the mammal fauna of King Leopold sandstones and contributes to the knowledge of the fauna of the proposed National Park.

Investigation of the King Leopold Sandstones and monsoon forest around Charnley Gorge indicate that this area in particular has an interesting and diverse mammal fauna worthy of further examination. In particular precise identification of Rock Wallabies, *Petrogale/Peradorcas*, Bandicoots, *Isoodon spp*, Tree Rats, *Mesembriomys/Conilurus* is required. Additionally the existence of two types of rock wallabies together in the same habitat is unusual and would be worth further study.

In spite of the superficial nature of this survey our results do allow some comment on the assemblage of mammals at Walcott Inlet and Munja. The general conclusion is, as it was for the birds, that the fauna is more typical of more humid, wetter areas further north.

The average annual fainfall at Munja is probably *ca* 900 mm (extrapolation from data in Rainfall Map - Western Australia Yearbook 1975). Other areas where fauna surveys have been done, in north west and central Kimberley, are all wetter. For example, the Drysdale River National park straddles the 1000 mm isohyet, Kabay *et al.* (1977); three quarters of the Prince Regent Reserve lies within the 1200-1400 mm isohyet, (Ibid) and the Mitchell Plateau, one of the wettest areas in WA has an annual average of 1583 mm (Wilson 1981). In spite of its relative aridity, the Munja area has a mammal fauna superficially more similar to the Prince Regent River Reserve than the Drysdale River National Park, see McKenzie *et al.* (1975, 1977). Additionally, discounting the record from Broome (see Burbidge, 1983)

Wyulda squamicaudata at Charnley Gorge is the most southerly record at present.

One aspect of the fauna of Munja Plain which is unexplained, is the scarcity of macropods. It is unlikely to be due to competitive grazing by cattle as five species of large macropod persist in the Phanerozoic South-west Kimberley in spite of grazing competition, (McKenzie 1981). Also Gooding & Harrison (1952) report a proliferation of *Macropus agilis* on the Ord River after grazing. As far as the persistence of other species on Munja Plain and surrounds is concerned, McKenzie (1981), has briefly reviewed the Kimberley situation. The general conclusion is that although many species have declined with grazing and burning practices associated with the pastoral industry in more arid parts of Australia, in humid and tropical areas most native mammal species have survivied in spite of grazing. This conclusion is borne out by the observations of Wattie Ngerdu, who recalls no major change to the mammal fauna of the area since the advent of the pastoral industry here in 1944. Additionally in the Walcott Inlet area most mammals are found in sandstones and vine thickets which although visited by cattle are not extensively grazed.

ACKNOWLEDGEMENTS

The Australian and New Zealand Scientific Exploration Society provided my air-fare to the Kimberley. Ian Maley organised and led the expedition. Members of the expedition kindly carried traps, spotlights, etc and provided details of their observations. Dave Fell and Warren Lloyd managed a trapline. Wattie Ngerdu with patience and good humour, imparted his knowledge of animals in the area. Department of Conservation and Land Management (formerly Fisheries and Wildlife) loaned traps and a spotlight and the WA Museum provided collecting equipment and confirmed identifications. N.L. McKenzie and D.J. Kitchener commented on an early draft. June Anderson typed the manuscript.

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BIRDS OF THE MUNJA-WALCOTT INLET AREA WEST KIMBERLEY, WESTERN AUSTRALIA.

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INTRODUCTION

The three of us recorded bird data while in the Munja-Walcott Inlet area between 1-27 May 1983, participating in the Australian and New Zealand Scientific Exploration Society (ANZSES) 1983 Kimberley expedition. All data were recorded opportunistically while exploring the area on foot. Additionally, a 4m aluminium runabout was available for access to the Calder and Charnley Rivers.

With the exception of some bird notes by Rev. McMillan for 'Munja Lagoon' in the early 1950's, which are recorded in Storr (1980) no naturalists we are aware of have recorded data in the general area prior to this expedition. However since this expedition several sites near Walcott Inlet were surveyed between June 1987 and March 1989 as the Kimberley component of the National Rainforest Programme. One site in particular, 21/4, located at 124° 58' 30"E 16° 21' 20"S was surveyed for birds by Johnstone and Burbidge (1991). This site was described as "swamp or riverine situation on alluvial soil"; it is within several hundred metres of both the 'garden lagoon' and 'gallery forest' described in this paper.

The general area and specific habitats within it are described in Kenneally and Edinger (this publication). However, sites of faunal interest are described briefly below. Some of the areas examined by us particularly the south side of the Charnley River, are included in the proposed Walcott Inlet National Park (see Burbidge et al. 1991).

Site 1

Base camp. A small area (<0.5 ha) or riparian woodland on the Calder River where it is joined by Neville Creek at 124° 58'E 16° 19'S. Prominent tree species are *Melaleuca leucadendra*, *Lysiphyllum cunninghami* and *Terminalia*.

Site 2

Charnley River monsoon forest. A discrete patch of monsoon forest and vine thicket of ca 5-10 ha extent on the Charnley River at 124° 59'E 16° 23'S. Rough and tumbled King Leopold Sandstone is immediately continuous with this site.

Site 3

Ravine in Harding Range. A valley incised into the Harding Range escarpment with extensive (*ca* 10-15 ha) monsoon forest and vine thicket at the valley head. A small creek with riparian woodland on basaltic rocks formed the ravine which fed into Neville Creek. Located at 124° 58'E 16° 15'S.

Site 4

Gallery Forest. An isolated tall dense forest community located in a minor watercourse on the edge of King Leopold Sandstone at 124° 58' 30"E 16° 21' 00"S.

These sites are shown in Figure 1 in Kenneally and Edinger (this publication). Other more extensive habitats examined were:

1. Munja Plain, a low lying alluvial expanse of grassland with numerous lagoons, some surrounded by woodland.
2. Savannah woodland which occurs between the Harding Range and the Calder River.
3. Low open woodlands on sandstone; Warton Sandstone on the Harding Range escarpment and King Leopold Sandstone elsewhere.

Extensive mangroves which mainly occur where Walcott Inlet is much wider were not examined.

An attempt was made to examine 'Munja Lagoon', located by Storr (1980) at 124° 55'E 16° 21'S. These co-ordinates are in error as there is no lagoon here. A lagoon very close to the old Munja settlement at 124° 56' 45"E 16° 21' 45"S was quite unproductive. Another lagoon at 124° 58' 45"E 16° 21' 20"S, designated 'garden lagoon' by its presumed proximity to the Munja gardens was the ;most productive for waterfowl (see annoted list).

Data were recorded quantitatively as well as qualitatively; assessments were make as follows:

Scarce:	1 or 2	observations for the expedition's duration
Uncommon:	2 to 10	observations for the expedition's duration
Moderately Common:	10 to 50	observations for the expedition's duration
Common:	50 to 100	observations for the expedition's duration
Very Common:	100 plus	observations for the expedition's duration

One of us (TM) set a 20m mist net in Neville Creek monsoon forest (Site 3) at 0800 hours on 23 May 1983. The net was operated continuously until 1200 hours on 25 May 1983. Capture data are presented elsewhere in this report. All birds were released 1km from capture site to avoid recapture.

It was hoped that mist-netting would detect whether Rainbow Pittas were present in the monsoon forest in the upper reaches of Neville Creek in the Harding Range (Site 3). No pittas were caught or observed in spite of the apparent suitability of the habitat and the successful capture of considerable numbers of other species. The mist net location turned out to be within a few metres of an active bower of a Great Bowerbird which may have chased off other species. Over a two day period the following birds were captured and released: Great Bowerbird: -three tines, Little Shrike-thrush: -six times, and Bar-shouldered Dove: -once.

Nomenclature follows (Storr 1980).

PELECANIDAE

Pelecanus conspicillatus - Australian Pelican.
Commonly seen; individuals and in small groups of 3-4 along Calder River and on sandbars at Calder/Charnley confluence. Seen fishing on Calder 'tidal meadow' at high tide. A group of 57 was seen flying high over Munja.

PHALACROCORACIDAE

Phalacrocorax sulcirostris - Little Black Cormorant.
Uncommon, one individual on billabong, small groups (5-6) flying over or along rivers.

Phalacrocorax melanoleucos - Little Pied Cormorant.
More frequently seen than *P. sulcirostris*, individuals on rivers and lagoons, small groups to 7 flying along rivers.

Anhinga melanogaster - Darter.
Approximately as abundant as *P. melanoleucos*, individuals and pairs, on lagoons, dead trees and on riverside rocks.

ARDEIDAE

Ardea pacifica - Pacific heron.
Uncommon, mostly individuals flying and perching in trees; also small groups of 3-4.

Ardea novaehollandiae - White-faced Heron.
Very common, usually individuals, occasionally pairs, on edge of rivers, in trees and eastern end of Walcott Inlet.

Egretta alba - Great Egret.
Uncommon, individuals on edge of rivers, once on lagoon.

Egretta garzetta - Little Egret.
Very common, individuals and groups of up to 15, usually on bard mud banks of rivers; also sandbars at eastern end of Walcott Inlet.

Egretta sacra - Eastern Reef Heron.
Uncommon, individuals (grey phase) seen on muddy spit in Walcott Inlet and on mud banks of rivers.

Butorides striatus - Mangrove Heron.
Uncommon, individuals on mud banks and in mangroves at east end of Walcott Inlet.

Nycticorax calendonicus - Rufous Night Heron.
Uncommon, individuals in riparian woodland along upper Calder River and lower Charnley River.

CICONIIDAE

Ephippiorhynchus asiaticus - Black-necked Stork.
Uncommon, individuals, usually seen flying over/along rivers. One on sandbar at Calder/Charnley confluence.

THRESKIORNITHIDAE

Threskiornis spinicollis - Straw-necked Ibis.
Common, usually medium sized groups of up to 15, perching in riverside trees on Munja Plain. A group of 50 plus flying over lower Calder River.

Threskiornis aethiopicus - Sacred ibis.
Less common and in smaller groups (usually 2-3) than *T. spinicollis*. Always on riverside (cf. *T. spinicollis)*, sometimes with *Egretta garzetta*.

Platelae regia - Royal Spoonbill.
Scarce, one only seen on riverside 'tidal meadow' at high tide on Calder River.

ANATIDA

Anseranas semipalmata - Pied Goose.
Moderately common, group between 3-8 in trees around lagoons. One group of 60 plus in lagoon and surrounding trees.

Cygnus atratus - Black Swan.
Not seen by us but reported in the 1950's from 'Munja Lagoon' (Storr 1980).

Dendrocygna arcuata - Chestnut Whistling Duck.
Uncommon, one group of seven in mangroves at eastern end of Inlet.

Nettapus pulchellus - Green Pygmy Goose.
Uncommon, one group of six on 'garden lagoon'.

ACCIPITRIDAE

Haliastur indus - Brahminy Kite.
Moderately common, usually singly over lower reaches of rivers; also pairs perching in low riverside vegetation.

Haliastur sphenurus - Whistling Kite.
Status uncertain, usually very common or few individuals continually present at riverside camps. Calling persistently.

Milvus migrans - Black Kite.
Uncommon, singly or in pairs at riverside camps after several days occupancy.

Accipter fasciatus - Brown Goshawk
Uncommon, one bird, a female, over lower Charnley River. Others could not be readily distinguished from *A. cirrocephalus*.

Aquila morphnoides - Little eagle.
Scarce, one flying over King Leopold Sandstone.

Aquila audax - Wedge-tailed Eagle.
Uncommon, occasionally over rivers, usually in Harding Range. A disused nest in eucalypt on Munja Plain.

Haliaeetus leucogaster - White-breasted Sea Eagle.
Moderately common over lower reaches of rivers and eastern end of Walcott Inlet. Occasionally flying over trees on Munja Plain. One juvenile seen.

Circus assimilis - Spotted Harrier.
Uncommon, over lower reaches of rivers and Munja flood plain.

Circus aeruginosus - Marsh Harrier.
Scarce, one over 'garden lagoon'.

FALCONIDAE

Falco peregrinus - Peregrine Falcon
Scarce, perching in dead tree on Munja Plain, also flying over river.

Falso longipennis - Australian Hobby.
Scarce, one at Calder/Charnley confluence, another persistently seen at dusk flying over tree tops feeding on dragonflies in Harding Range ravine.

Falco berigora - Brown Falcon.
Uncommon, seen individually over Munja, along creeks and rivers.

Falco cenchroides - Australian Kestrel
Scarce, one on Boab tree at Munja.

GRUIDAE

Grus rubicundus - Brolga
Common, in small groups of up to 8-9 and singly on Munja Plain. Tidal meadows and lagoons.

OTIDIDAE

Otis australia - Bustard.
Uncommon, singly and in pairs over and in savannah woodlands, one group of 8 on long, thin island in Walcott Inlet.

JACANIDAE

Jacana gallinacea
Not seen by us but reported in the 1950's from 'Munja Lagoon', (Storr 1980).

CHARADRIIDAE

Vanellus miles - Masked Plover.
Uncommon, a pair repeatedly seen on rockbar in Calder River opposite Munja.

Charadrius melanops - Black-fronted Plover.
Uncommon, usually in pairs on rocky river bed in Calder River in vicinity of base camp, calling persistently.

SCOLOPACIDAE

Numenius phaeopus - Whimbrel.
Scarce, single birds and a group of three near Charnley River mouth on sandbar.

Tringa hypoleucos - Common Sandpiper.
Scarce, individuals seen on banks of Calder and Charnley Rivers.

RECURVIROSTRIDAE

Himantopus himantopus - Black-winged Stilt.
Common, groups of up to *ca* 25 observed flying upstream along Calder and Charnley Rivers. Flocks of *ca* 200, 50 and 20 on sandbar at Calder/Charnley confluence.

BURHINIDAE

Burhinus grallarius - Bush Stone Curlew.
Scarce, heard on one occasion at night at base camp.

LARIDAE

Larus novaehollandiae - Silver Gull.
Scarce, small group of 3-4 seen flying over Walcott Inlet. Common at Koolan Island.

Sterna caspia - Caspian Tern.
Scarce, one flying along lower reaches of Charnley River.

Sterna bergii - Crested Tern.
Uncommon, small groups of 2-3 at Walcott Inlet, one group of 8 at Calder River opposite Munja.

Sterna hybrida - Whiskered Tern.
Common, usually in small groups of up to *ca* 10 flying over lower reaches of rivers and lagoons. One group of *ca* 40.

COLUMBIDAE

Ducula bicolor - Torres Strait Pigeon.
Moderately common, singly and in pairs in Charnley River monsoon forest (site 2), Gallery forest (site 4), Harding Range monsoon forest (site 3). Calling persistently. Two 'atypical' habitat records in riparian woodland along Neville Creek. Probably feeding on fruits of *Diospyros ferrea* at site 3.

Geopelia humeralis - Bar-shouldered Dove.
Common, seen and calling persistently in all monsoon forests and riparian woodlands.

Geopelia striata - Peaceful Dove.
Common, seen and calling persistently in all woodland habitats.

Chalcophaps indica - Green-winged Pigeon.
Scarce, seen on ground in dense leaf litter at Charnley River vine thicket (site 2) and Harding Range monsoon forest (site 3). Probably feeding on withered fruits of *Diospyros ferrea* at site 3.

Petrophassa albipennis - White-quilled Rock Pigeon.
Moderately common, singly and in small groups of up to 3 in sandstone habitats of the Harding Range.

Trichoglussus haematodus - Rainbow Lorikeet.
Moderately common, usually seen flying in small groups of 2-3. One group of 5-6 feeding in gallery forest (site 4).

Trichoglussus versicolor - Varied Lorikeet.
Uncommon, always in pairs flying high and fast, usually along rivers.

Asprosmictus erythropterus - Red-winged Parrot.
Uncommon, in small groups of 3-4 in savannah woodland and riparian woodland.

Calyptorynchus magnificus Red-tailed Black Cockatoo.
Common, in groups of up to 15 along rivers and in Harding Range (site 3).

Cacatua tenuirostris - Corella.
Common, groups of more than 200 plus, often around base camp. Smaller groups of 4-5 elsewhere, including savannah woodlands.

Cacatua galerita - Sulphur-crested Cockatoo.
Uncommon, small groups of 2-3 in savannah woodland, low open woodland on King Leopold Sandstone, and riparian woodland.

CUCULIDAE

Centropus phasianinus - Pheasant Coucal.
Uncommon, single birds in gallery forest (site 4), savannah woodland and low open woodland on King Leopold Sandstone, and in tall rank grassland.

STRIGIDAE

Ninox connivens - Barking Owl.
Scarce, heard on one occasion at Charnley River campsite (site 2).

AEGOTHELIDAE

Aegotheles cristatus - Australian Owlet Nightjar.
Scarce, heard on one occasion in ravine in Harding Range (site 3).

CAPRIMULGIDAE

Eurostopodus guttatus - Spotted Nightjar.
Scarce, one bird repeatedly seen hawking over Calder River at dusk at base camp.

ALCEDINIDAE

Alcedo azurea - Azure Kingfisher.
Scarce, two seen, flying along Charnley River at site 2.

Dacelo leachii - Blue winged Kookaburra.
Uncommon, heard in riparian woodland on Calder River and gallery forest (site 4).

Halcyon sancta - Sacred kingfisher.
Scarce, seen and heard in gallery forest (site 4) and Charnley River monsoon forest (site 2).

MEROPIDAE

Merops ornatus - Rainbow Bee-eater.
Common, seen and heard in small groups of 2-3 in all habitats except monsoon forest.

ALAUDIDAE

Mirafra javanica - Horsefield's Bushlark.
Common in tall dense grassland on Munja Plain.

HIRUNDINIDAE

Hirundo ariel - Fairy Martin.
Old nests in King Leopold Sandstone in Charnley River gorge.

CAMPEPHAGIDAE

Coracina novaehollandiae - Black-faced Cuckoo-shrike.
Common, small groups of 2-3 in most habitats except monsoon forest.

Coracina papuensis - Little Cuckoo-shrike.
Uncommon, single birds in riparian woodland, gallery forest (site 4) and in low open woodland on Warton Sandstone in the Harding Range.

Lalage sueurii - White-winged Triller.
Scarce, single birds in riparian woodland and low open woodland on King Leopold Sandstone.

Lalage leucomela - Varied Triller.
Uncommon, single birds monsoon forest (site 2), riparian woodland and Harding Range ravine (site 3). Apparently in denser vegetation than *L. sueurii*. Feeding on small white fruits of *Ficus leucotricha* in riparian woodland along Neville Creek.

PACHYCEPHALIDAE

Pachycephala rufiventris - Rufous Whistler.
Common, seen singly and in pairs, and heard in all habitats.

Colluricincla megarhyncha - Little Shrike Thrush.
Locally very common in monsoon forest/vine thicket in ravine in Harding Range (site 3). Not seen elsewhere.

MONARCHIDAE

Rhipidura rufiventris - Northern Fantail.
Moderately common in riparian woodland in ravine in Harding Range. Other fantails seen on the Calder River and on Mt Daglish were not positively identified.

Rhipidura leucophrys - Willie Wagtail.
Locally common along riparian woodlands, apparently absent or very scarce in other habitats.

Myiagra rubecula Leaden Flycatcher.
Status uncertain. One female positively identified in vine thicket in Harding Range ravine (site 3), other grey-headed Flycatchers with tawny throats seen in a wide variety of habitats could not be ascribed to this species or M. *reficollis*.

Myiagra inquieta - Restless Flycatcher.

Uncommon, though always present at base camp. Heard on Charnley River.

ORTHONYCHIDAE

Pomatostomus temporalis - Grey-crowned Babbler.
Uncommon, small groups of up to 6 seen in low open woodland on Warton and King Leopold Sandstones and in savannah woodland.

ACANTHIZIDAE

Gerygone chloronota - Green-backed Warbler.

Identification uncertain. A small nondescript warbler with a call very similar to G. *fusca* was moderately common in riparian woodlands.

Smicrornis brevirostris - Weebill.
Uncommon, in small groups of 3-4 in riparian woodlands but more often in savannah woodlands.

MALURIDAE

Malurus lamberti - Variegated Fairy-wren.
Scarce, one male, three females in *Pandanus* with grasses on Warton Sandstone in Harding Range.

Malurus melanocephalus - Red-backed Fairy-wren.
Scarce, one male in eclipse plumage in dense grasses on bank of Calder River. A small group of 2-3 in rank grassland on Munja Plain.

SYLVIIDAE

Cisticola exilis - Golden-headed Fantail Warbler.
Moderately common, small groups of 2-3 in tall dense grassland on Munja Plain.

CLIMACTERIDAE

Climacteris melanura - Black-tailed Tree-creeper.
Scarce, individual birds seen in savannah woodland and low open woodland on Warton Sandstone in Harding Range.

DICAEIDAE

Dicaeum hirundinaceum - Mistletoebird.
Common, individual birds seen in all habitats with trees including mangroves.

PARDALOTIDAE

Pardalotus striatus - Striated Pardalote.
Common, small groups of 2-3 and individuals in all habitats with trees except vine thicket/monsoon forest.

MELIPHAGIDAE

Lichmera indistincta - Brown Honeyeater.
Very common in small groups of 3-4 in most habitats; scarce in vine thicket/monsoon forest.

Meliphaga flavescens - Yellow-tinted Honeyeater.
Scarce, two birds seen in *Pandanus* in gallery forest (site 4).

Meliphaga unicolor - White-gaped Honeyeater.
Common, individuals and small groups in all habitats with trees. Observed feeding on flowering *Eugenia*, mistletoe, *Xanthostemon paradoxus* and fruits of *Trema*.

Melithreptus gularis - Black-chinned Honeyeater.
Scarce, pairs and individuals, in low open woodland on sandstone including summit of Mt Daglish.

Melithreptus cyanotis - Blue-faced Honeyeater.
Scarce, one in *Pandanus* in gallery forest.

Philemon citreogularis - Little Friarbird.
Scarce, single birds seen in low open woodland on King Leopold Sandstone and in savannah woodland.

Philemon argenticeps - Silver-crowned Friarbird.
Scarce, one in savannah woodland.

Cissomela pectoralis - Banded Honeyeater.
Scarce, two seen in low open woodland in King Leopold Sandstone.

Ramsayornis fasciatus - Bar-breasted Honeyeater.
Scarce, one in Warton Sandstone on plateau of Harding Range.

PLOCEIDAE

Neochmia phaeton - Crimson Finch.
Uncommon, small groups of up to 5 in savannah woodland, feeding on ground in riparian woodland, and in *Sorghum* grasses on edge of gallery forest.

Poephila bichenovii - Double-barred Finch.
Common, single birds and pairs in grasses in riparian woodland, in *Pandanus* by sandstone. A pair with nest in *Melaleuca leucadendra* by Calder River.

Poephila acuticauda - Long-tailed Finch.
Scarce, one group of 3 in savannah woodland by Neville Creek.

Erythrura gouldiae - Gouldian Finch.
Scarce, one group of 5 in savannah woodland by Neville Creek.

Lonchura castaneothorax - Chestnut-breasted Mannikin.
Scarce, groups of up to 9 in *Eucalyptus papuana* savannah woodland and in riparian woodlands.

ORIOLIDAE

Oriolus flavocinctus - Yellow Oriole
Moderately common, single birds in gallery forest (site 4), and in Charnley River monsoon forest (site 2). This species was distinguished from O. *sagittatus* by more complete striping on lower ventral surface. O. *sagittatus* may also have been present here.

Oriolus sagittatus - Olive-backed Oriole.
Scarce, one in riparian woodland in Neville Creek.

Sphecotheres viridis - Figbird.
Scarce, one male and a small group in riparian woodland in Harding Range ravine.

DICRURIDAE

Dicrurus megarhynchus - Spangled Drongo.
Moderately common, singles and pairs in Charnley River monsoon forest (site 2), Harding Range ravine monsoon forest (site 3) and gallery forest (site 4).

GRALLINIDAE

Grallina cyanoleuca - Magpie Lark.
Moderately common, in groups of up to 9 in lower reaches of rivers.

ARTAMIDAE

Artamus minor - Little Woodswallow.
Moderately common, groups of 3-4, mainly around Harding Range escarpment including Mt Daglish. Also perched in savannah woodland, and over sandstones and lagoons.

CRACTICIDAE

Cracticus torquatus - Grey Butcherbird.
Uncommon, heard only, in Harding Range ravine and riparian woodland along Neville Creek.

Cracticus nigrogularis - Pied Butcherbird.
Moderately common, single birds in riparian and savannah woodlands.

PTILONORPHYNBCHIDAE

Ptilonorhynchus nuchalis - Great Bowerbird.
Common, individual birds seen in all habitats except grassland and savannah woodland. Feeding on fruits of *Celtis philippensis*.

Corvus orru - Australian Crow.
Scarce, one on Boab tree on Munja Plain.

Corvus bennetti - Little Crow.
Common, small groups of up to 6 in most habitats; often flying up and down rivers.

DISCUSSION

With 111 species recorded, most of the prominent Kimberley bird families are represented in the Munja-Walcott Inlet area. Some families, eg finches (Ploceidae) with 5 species and raptores (Accipitridae and Falconidae), with 14 species, are particularly well represesented. Not recorded by us but probably present are quails (Phasianidae) and more particularly button-quails (Turnicidae), rails (Rallidae) and cuckoos (Cuculidae).

Other observers and more particularly observations in other seasons especially the end of the dry, would add other species. However a dry season list of 15 species for site 21/4 recoreded by Johstone and Burbidge (1991) only listed White-browed Robin not listed by us.

By Australian standards the Munja-Walcott Inlet area has a very rich and diverse avifauna. Most of our data (except a few species from the Inlet) were obtained from an area less than 4 x 15km or 6,000ha. Elsewhere in Australia greater areas, or considerably more effort, are required to record more than 100 species. The reason for the high number of species at Munja is simply the high degree of habitat diversity within a small area. For example within the 12km from Munja settlement to site 4, the following habitats were

present: tidal flats, alluvial plain with grassland, lagoons, riparian woodland, monsoon forest, vine thicket and low open woodland on sandstone.

The lagoons on Munja Plain were of particular interest to us. However, with only seven species recorded these were less productive than anticipated. Perhaps an excessively wet and late monsoon season in 1982-83 allowed other species of waterfowl to be widely dispersed throughout the Kimberley at the commencement of the dry season. Extensive waterfowl dispersal following heavy, unseasonal rains has been demonstrated in the south-west of Western Australia (Bekle 1983).

Some waterfowl, particularly herons, ibises, egrets and pelicans were much more abundant on the Calder than the Charnley River. This relate to the Calder having *ca* 6km of tidal lower reaches compared to 3km for the Charnley. Additionally, 'tidal meadows' ie narrow margins of semi-aquatic grassland which are awash at high tide, are better developed on the former river. The greatest number of species were recorded on the Calder River on 15 May 1983 at hight tide which was 10.3 metres at Koolan Island. It was particularly noticeable that numbers of waterfowl diminished rapidly downstream of the Calder/Charnley confluence where salinity was noticeably higher.

The most interesting aspect of bird zoogeography in the Munja area relates to the presence of monsoon forest and vine thickets. These formations are at their most southerly in Western Australia at the northern end of the Dampier Peninsula, Kenneally (1983), at a latitude only a few minutes south of Walcott Inlet. Accordingly we did not expect to find such extensive and well developed areas of these formations here. The following species were only recorded in monsoon forest/vine thicket: Torres Strait Pigeon, Green-winged Pigeon, Sacred Kingfisher, Yellow Oriole and Spangled Drongo. Of these Green-winged Pigeon, [known previously south to the Carson escarpment, Storr (1980)] is a minor extension of range. Neither Torres Strait Pigeon nor Green-winged Pigeon occur in the Dampier Peninsula vine forests (see Johnstone 1983).

The bird community in the monsoon first at site 3 was observed in enough detail by one of us (TM, who spent 6 days there) for some observations to be made, in addition ot the general checklist for this area. An estimation of relative abundance of the species in this community (including mist-netting results) is as follows:

Little Shrike-thrush	abundant
Yellow Oriole	common
Bar-shouldered Dove	common
Great Bowerbird	common
White-gaped Honeyeater	fairly common
Green-winged Pigeon	fairly common
Northern Fantail	fairly common
Green-backed Flyeater	present
Varied Triller	present

Leaden flycatcher	present
Torres Strait Pigeon	present
Mistletoebird	uncommon
Spangled Drongo	uncommon
Figbird	uncommon
Rufous Whistler	uncommon

Fleshy fruits were common in the monsoon forest at the time of our visit; the following were available; figs (*Ficus* spp.), *Diospyros ferrea*, *Cassine melanocarpa*, *Celtis philiphenses*, *Citriobatrus spinescens*, *Fissistigma* and *Randia cockinchinensis*.

The most common birds are insectivores and frugivores. The Little Shrike-thrush was observed feeding at all levels in the forest, however it foraged little on the ground. There are at least three species of pigeons in this forest: Torres Strait Pigeon, feeding on fleshy fruit in the canopy and passing intact, viable seeds in its faeces; Green-winged Pigeon, feeding mainly on the ground and Bar-shouldered Dove, feeding exclusively on seeds on the ground.

Apart from the uncommon Mistletoebird there are no species relying entirely on fleshy fruits. Yellow Oriole, Great Bowerbird and Varied Triller all have mixed diets. The most specialised fruit eaters are probably Torres Strait Pigeon and Figbird. An interesting feature of this forest is the poor representation of parrots and honeyeaters. No parrot was observed and the only honeyeater was White-gaped Honeyeater, a species feeding perhaps more on fleshy fruits than on nectar. Three species of very small insectivores occupied the canopy: Northern Fantail (sallying), Leaden Flycatcher (sallying and gleaning from leaves) and Green-backed Flyeater (gleaning from leaves). Spangled Drongo and Rufous Whistler were larger, hook-billed insectivores but relatively uncommon and possibly dependent upon openings in the canopy. Finally a striking feature of the bird community was the lack of any purely or even predominantly ground feeding invertebrate eaters. Casual observation indicated the nocturnal aerial insect-eating role in the forest (or at least in the relatively open tracts along the creek) is taken by at least one, probably two, species of high-flying bat and one species of low-flying fluttering bat.

ACKNOWLEDGEMENTS

The Australian and New Zealand Scientific Exploration Society provided our fares to the Kimberley. Ian Maley organised and led the expedition. We are grateful to many expedition members who provided data. Others approached us with the statement "I saw a bird which ..." The ensuing conversation often provided further data or caused us to consider factors which might otherwise have been overlooked. The late G.M. Storr commented on a draft of this paper. June Anderson typed the manuscript.

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THE FLORA OF A REMNANT OF NATIVE VEGETATION ON THE EASTERN SWAN COASTAL PLAIN.

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INTRODUCTION

The increased requirement for land, to meet demands for housing and industrial development, in the immediate vicinity of Perth has lead to the clearing of much of the native vegetation on the Swan Coastal Plain. Despite increasing public awareness of the need to conserve representative areas of natural bushland, in many suburbs that option no longer exists. Areas of natural bushland may however still be present but are privately owned or are vested in local, state or federal government bodies. In many cases, the conservation of the flora and fauna over significant portions of these holdings will not conflict with the landholders' operations. Providing the landholders' rights are respected, such areas can become valuable islands in the urban sprawl. Of particular importance is the fact that the isolation of such remnants from the general public affords them a level of protection that is virtually impossible to provide on public lands.

This paper describes the flora of a remnant patch of vegetation located on the Swan Coastal Plain at Forrestfield (15 km east of Perth), adjacent to the Darling Scarp.

SITE DESCRIPTION

The remnant vegetation described in this paper occurs on land owned by the State Government and managed by the Agriculture Protection Board of Western Australia (APB). The APB complex at Forrestfield covers an area totalling 13.8 ha., of which approximately 8 ha. remain as natural vegetation (Figure 1).

The area is surrounded by a 2 m high security fence and the boundaries and buildings are surrounded by graded fire-breaks. There has been minimal intrusion of introduced weed species, such as African Lovegrass (*Eragrostis curvula*) and Veldtgrass (*Ehrharta calycina*), into the areas of native vegetation.

The APB has managed the site since 1971, and during that time there have been no fires in any sections of the complex. However a fire did burn through the area in the summer of 1969/70 (Tony Oliver pers. comm.). Burnt stumps and fire scars on many of the larger Jarrah (*Eucalyptus marginata*) trees indicate that there have been other fires in the recent past. Records held by the Department of Conservation and Land Management indicate that the area was never logged for timber on a commercial basis,

however there are clear indications that small amounts of timber have been cut at some time during the past.

The geology of the area is characterized by siliceous soils of aeolian origin overlying alluvial clays (Marchant *et al.* 1987). There are no swamps or winter wet depressions on the site.

The vegetation is mature and in most places forms a dense cover to about one metre high. Within the small area encompassed by the site there is considerable variation in the vegetation associations. Open Banksia woodland over low heath, open Jarrah woodland over low heath and low heath alone, are all represented. The variation in vegetation appears to be associated with underlying soil profiles, with the open banksia woodland confined to the areas with deeper white sands. Several species of plant are associated with only one type of soil profile and as such are confined to only a few locations within the site.

METHODS

Plant specimens were collected opportunistically during the period August 1989 to November 1992. Where possible, all collections included flowering material. Duplicate specimens were taken at the time of collection, one being sent as a voucher specimen to the State Herbarium for confirmation of identification and the other retained at the APB's research laboratories. Unless otherwise noted, the identification of specimens was confirmed by staff at the Western Australian Herbarium.

Collections were limited to the naturally occuring flora and did not include any introduced species.

RESULTS AND DISCUSSION

The plant species known to be present at the site are listed in Appendix 1. Nomenclature follows Marchant *et al.* (1987). The exact identity of several specimens remains to be confirmed, but these have been treated as distinct taxa for the purpose of this paper.

A total of 182 flowering plant taxa were recorded within the APB complex, belonging to 106 genera and 34 families. The families Proteaceae (26 species), Papilionaceae (15), Myrtaceae (13), Orchidaceae (13) and Anthericaceae (12) are the richest in species (Table 1).

The presence of at least 182 species of plant from 34 families indicates that this floral community is rich and diverse. It is important to note that no species of the family Asteraceae were recorded during the survey. This is

almost certainly due to the fact that the area has not been burnt for more than twenty years. Similarly the number of species recorded for the families Poaceae and Orchidaceae might well be better represented after a fire.

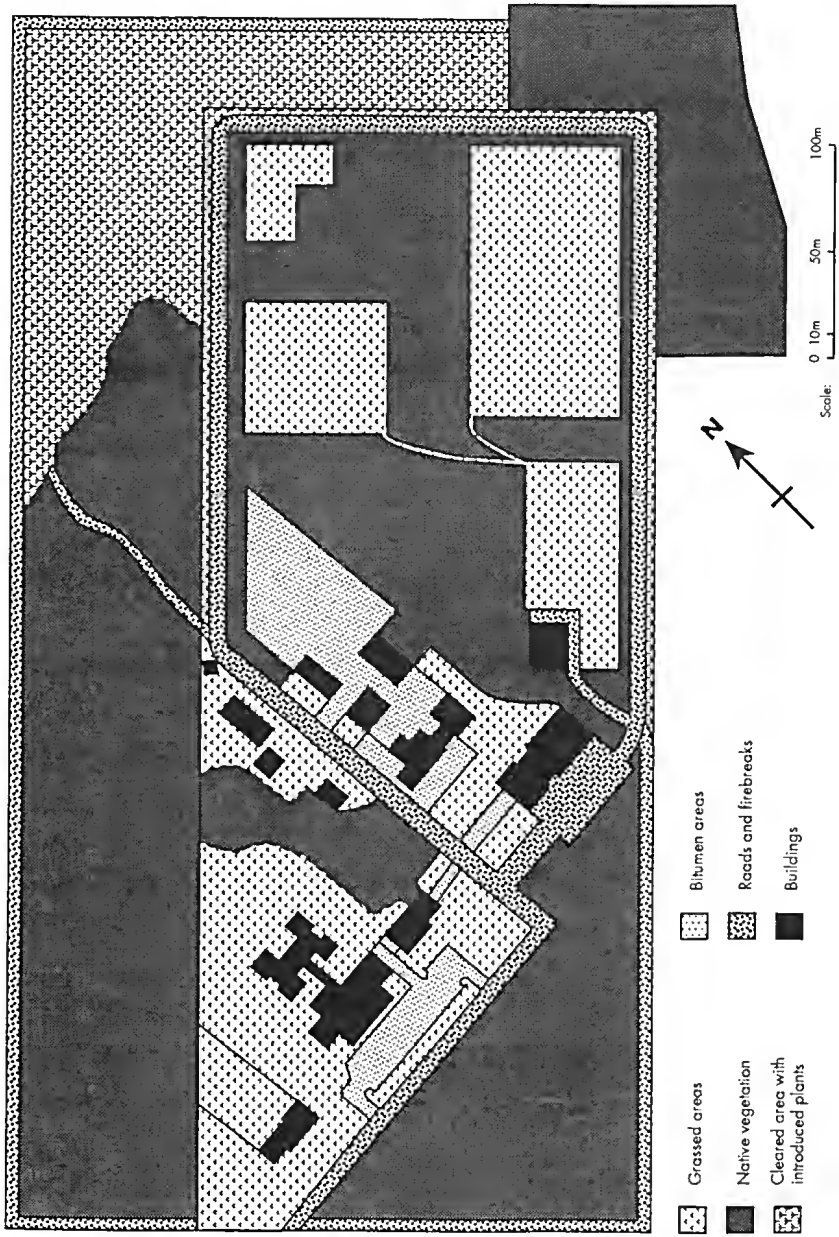

Fig 1 Agriculture Protection Board of Western Australia Forrestfield Complex

Table 1. The number of taxa recorded at Forrestfield for each family. Family sequence follows Marchant *et al.* (1987).

Family	No. Taxa	Family	No. Taxa
Lauraceae	3	Polygalaceae	2
Casuarinaceae	2	Rutaceae	2
Dilleniaceae	5	Apiaceae	3
Droseraceae	5	Chloanthaceae	1
Violaceae	1	Lamiaceae	2
Epacridaceae	9	Goodeniaceae	4
Pittosporaceae	2	Stylidiaceae	7
Mimosaceae	4	Xanthorrhoeaceae	2
Caesalpiniaceae	1	Anthericaceae	12
Papilionaceae	15	Dasypogonaceae	9
Proteaceae	26	Cholchicaceae	1
Thymeleaceae	1	Iridaceae	2
Myrtaceae	13	Orchidaceae	13
Olacaceae	1	Haemodoraceae	10
Loranthaceae	2	Cyperaceae	9
Euphorbiaceae	2	Restionaceae	5
Rhamnaceae	1	Poaceae	5

As an indication of the diversity and richness of the Forrestfield site comparisons were made with the following locations. Kings Park (Bennett 1988), John Forrest National Park (Department CALM, unpublished data), Fitzgerald River National Park (Aplin and Newby 1990), Moore River to Jurien Sandplain (Griffin and Keighery 1989) and the Mount Lesueur area (Burbidge, Hopper and van Leeuwen 1990). The comparison was limited to considering which species were common to both the Forrestfield site and each of the other locations. The results of the comparison are presented in Table 2.

Table 2. Number of indigenous plant species which are recorded at Forrestfield and which are also recorded in other published floras.

	Number of taxa shared with Forrestfield				
Location	J.F.N.P	Kings Park	F.R.N.P.	Moore R. to Jurien	Mt. Lesueur
No. of Species	96	101	68	128	129

The flora is dominated by species normally associated with the Swan Coastal Plain but it also contains significant elements of the Darling Scarp and both the northern and southern sandplain floras.

At the species level, the number of shared taxa indicates closer affinities between Forrestfield and the two northern sandplain floras than to the other sites. This suggests that, despite the close proximity of the Forrestfield site to the Darling Scarp, the difference in soil types (exposed granite and laterite on the scarp, leached white sands over clays at Forrestfield) has a greater influence on the floristic makeup of the area than does location.

The presence of a number of species at the site is noteworthy.

One Priority Code 1 species (*Isopogon drummondii*), four Priority Code 3 species (*Conospermum undulatum*, *Dryandra* sp. #22 (aff. *pteridifolia)*, *Haemodorum loratum* and *Olax scalariformis*) and one Priority Code 4 species (*Drosera occidentalis*) are present on this site (for Priority Codes see CALM 1992). Although a census has not been taken, all except *Olax scalariformis* would have local populations in excess of 100 plants.

A recently described variety of *Lambertia multiflora* (*L. multiflora* var. *darlingensis* ms) is recorded as being restricted to the lower Darling Scarp and is listed as a Code 3 species. New varieties of *Verticordia densiflora* have also recently been described, two of which are listed as Code 3 species (CALM 1992). At the time of going to press we have not been able to determine whether the *Lambertia*, the *Verticordia densiflora* or the *Verticordia* sp. (aff. *densiflora*) found at the site belong to these taxa.

Isopogon drummondii and *Conospermum undulatum*, are both species which are only found in the Forrestfied area. Unfortunately this is not an area which is blessed with an abundance of reserves vested for the protection of native flora. The importance of the APB site for the protection of these species will depend on the future development of the suburb. *Drosera occidentalis*, *Haemodorum loratum* and *Olax scalariformis* have a much wider distribution but are nonetheless vulnerable and this site provides a high level of protection for the populations here.

Dryandra sp. #22 (aff. *pteridifolia*), *Dryandra* aff. *vestita* , *Stenanthemum humile*, *Xanthorrhoea drummondii*, *Olax scalariformis*, *Stipa pycnostachya* and *Cyathochaeta clandestina* are important finds. These species are not recorded as existing in the Perth metropolitan region (Marchant *et al.* 1987). *Dryandra* sp. (aff. *pteridifolia*), *Stenanthemum humile*, *Xanthorrhoea drummondii* and *Cyathochaeta clandestina* are present in reasonable numbers. *Olax scalariformis* and *Stipa pycnostachya* are less abundant and *Dryandra* aff. *vestita* is limited to a single specimen on this site, with a further two specimens known from the adjacent primary school.

Dryandra sp. #22 was known only from the Mogumber and Badgingarra areas. However the species was described by James Drummond in an area approximately 7 or 8 kms north of our site, in 1839 (Pieroni 1990). It had not been recorded again in the metropolitan area until it turned up during this survey.

Dryandra aff. vestita is an unusual form of the species in that it appears to reach a size of only approximately 50 cm high by 50 cm wide and it lacks the characteristic twist in the leaves that is found in other populations (Margaret Pieroni pers. comm.). Herbarium records show that the distribution of *Dryandra vestita* was previously thought to be restricted to the wheatbelt between Eneabba and Lake Grace. No records for the species had been recorded west of the Darling range. With only three specimens of this form found so far, there is an urgent need to widen the search for additional specimens. Despite strong support by the school principal for the preservation of the two specimens growing in the primary school grounds, they cannot be considered secure. The single specimen on the A.P.B. site is hard against the edge of a firebreak which also threatens its security. Thus the entire population must be considered at risk.

Stenanthemum humile was formerly known as *Cryptandra humilis* and the change is the result of Barbara Rye's recent revision of the Rhamnaceae. The revision has resurrected the old genus *Stenanthemum*. The nearest known populations of *Stenanthemum humile* are to be found near the Moore River (Barbara Rye pers. comm.).

Xanthorrhoea drummondii was previously known to occur from Dongara southwards, east of the Darling Range, as far as Wagin. In overall appearance the Forrestfield specimens closely resemble those found in the Eneabba and Badgingarra areas. The majority of the Forrestfield specimens grow in association with low heath from which they are shortly emergent.

Olax scalariformis was previously known only from the area between Gingin and Eneabba.

Stipa pycnostachya is found south of Perth and near Gingin.

Cyathochaeta clandestina is predominantly found near the south coast with some collections further north. It is very common on this site.

Tricoryne tenella is a poorly collected species with only five records at the W.A. Herbarium (Sue Patrick pers. comm.).

The record of *Eucalyptus lane-poolei* at Forrestfield (a single plant) is unusual in that this species is normally found on lateritic loam over granite, on the western side of the Darling Scarp (Brooker and Kleinig 1990). Apart from a small population at Gosnells and a doubtful record from Clackline, the species has a disjunct distribution which extends south from near Byford and north from Gingin (Napier *et al.* 1988).

The population of *Banksia incana* at Forrestfield represents the southern-most location for this species (Taylor and Hopper 1988) and the only surviving population in the metropolitan area.

Other species of plant occuring at Forrestfield represent extensions ((although small ones) to the known distributions as given in Marchant *et al.* 1987). *Caustis dioica* is known from Bullsbrook northwards, and *Hibbertia vaginata* from Canning River south to Busselton.

Seven species (*Acacia teretifolia, Cassytha glabella, Conothamnus trinervis, Levenhookia dubia, Stylidium pubigerum, Thelymitra nuda* and *Xanthosia candida*) normally restricted to the Darling Scarp, are found at the site.

Danthonia caespitosa, Haemodorum paniculatum and *Phlebocarya filifolia* are known from only a few locations on the coastal plain. *Phlebocarya filifolia* is also a rarely collected species (Marchant *et al.* 1987).

The existence of the two species of *Dasypogon* in sympatry has seldom been recorded on the Swan Coastal Plain.

Some specimens of *Kingia australis* at Forrestfield are in excess of 4m in height, suggesting an age of approximately 275 years (Lamont and Downes 1979). The tallest specimen, at a height of over 8m was recently blown over in a storm. This specimen would have been over 500 years old. Although *K. australis* is not uncommon throughout the coastal plain, specimens of this size are now rare.

CONCLUSION

Given the species richness and number of gazetted species or unusual population records listed for this floral assemblage, there is good reason to ensure the continued security of this remnant of native vegetation. It would be reassuring to know that areas (other than those with specific vestiture as flora reserves or similar) supporting rich floras such as this could be managed in such a way as to satisfy both the landholder's requirements and the need for conservation. This site would appear to provide an outstanding example of the benefits of this type of approach. The APB has not suffered as the user and through careful management has conserved an area which is considered by many botanists to be of outstanding merit.

ACKNOWLEDGEMENTS

We would like to thank Ray Cranfield and the staff at the Western Australian Herbarium and especially Sue Patrick for all her help in confirming the identification of the specimens and kindly reading and commenting on this manuscript. Eleanor Bennett, Kingsley Dixon and Bob Dixon of the Kings Park Gardens and Sue Moore, Bronwyn Keighery and Neil Gibson from the Department of Conservation and Land Management provided valuable help and support. Our thanks also go to Margaret Pieroni and Alex George for their advice concerning the *Dryandra* species and to Greg Keighery for sorting out the problems we were having with the genera *Tricoryne* and *Xanthorrhoea* . We are also grateful to Gary Martin and Tim Lowe for their asistance in collection and curation of the material, and to Tim for assistance in entering the data on computer. Toni Lumsden kindly prepared the figure.

We also appreciate the support of the Agriculture Protection Board of Western Australia for allowing us the use of the APB's research laboratories.

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Appendix 1. Floristic list of the Agriculture Protection Board's Forrestfield complex (species marked with the symbol ‡ have not been confirmed by the Herbarium). Nomenclature follows Marchant *et al.* (1987).

Family and species

LAURACEAE
- ‡ *Cassytha flava*
- *Cassytha glabella*
- *Cassytha racemosa* forma *pilosa*

CASUARINACEAE
- *Allocasuarina fraseriana*
- *Allocasuarina humilis*

DILLENIACEAE
- *Hibbertia huegelii*
- *Hibbertia hypericoides*
- *Hibbertia mylnei*
- *Hibbertia subvaginata*
- *Hibbertia vaginata*

DROSERACEAE
- ‡ *Drosera erythrorhiza*
- *Drosera macrantha*
- *Drosera menziesii*
- *Drosera occidentalis*
- *Drosera stolonifera*

VIOLACEAE
- *Hybanthus calycinus*

EPACRIDACEAE
- *Astroloma pallidum*
- *Astroloma stomarrhena*
- *Astroloma xerophyllum*
- *Conostephium pendulum*
- *Leucopogon conostephioides*
- *Leucopogon polymorphus*
- *Leucopogon sprengelioides*
- *Lysinema ciliatum*
- *Styphelia tenuiflora*

PITTOSPORACEAE
- *Pronaya fraseri*
- *Sollya heterophylla* Lindley

MIMOSACEAE
- *Acacia pulchella* var. *glaberrima*
- *Acacia stenoptera*
- *Acacia teretifolia*
- *Acaeia willdenowiana*

CAESALPINIACEAE
- *Labichea punctata*

PAPILIONACEAE
- *Bossiaea eriocarpa*
- *Burtonia conferta*
- *Daviesia decurrens*
- *Daviesia divaricata*
- *Daviesia nudiflora*
- *Daviesia preissii*
- *Daviesia triflora*
- *Gompholobium knightianum*
- *Gompholobium tomentosum*
- *Hovea trisperma*
- *Jacksonia floribunda*
- *Jacksonia lehmannii*
- *Nemcia capitatum*
- *Sphaerolobium* sp. (aff. *macranthum*)
- *Templetonia biloba*

PROTEACEAE
- *Adenanthos cygnorum*
- ‡ *Banksia attenuata*
- ‡ *Banksia grandis*
- *Banksia incana*
- *Banksia menziesii*
- *Conospermum undulatum*
- *Dryandra armata*
- *Dryandra nivea*
- *Dryandra sessilis*
- *Dryandra* sp. (aff. *pteridifolia*)
- *Dryandra* aff. *vestita*
- *Hakea conchifolia*

Hakea inerassata
Hakea prostrata
Hakea ruscifolia
Hakea trifurcata
Isopogon drummondii
Isopogon dubius
Lambertia multiflora
Persoonia elliptica
Persoonia saccata
Petrophile linearis
Petrophile macrostachya
Stirlingia latifolia
Synaphea spinulosa
‡ *Xylomelum occidentale*

THYMELAEACEAE
Pimelea suaveolens

MYRTACEAE
Baeckea camphorosmae
Calytrix fraseri
Conothamnus trinervis
Eremaea fimbriata
Eremaea pauciflora
Eucalyptus calophylla
Eucalyptus lane-poolei
Eucalyptus marginata
Eucalyptus todtiana
Melaleuca scabra
Scholtzia involucrata
Verticordia densiflora
Verticordia sp. (aff. *densiflora*)

OLACACEAE
‡ *Olax scalariformis*

LORANATHACEAE
Amyema miquelii
Nuytsia floribunda

EUPHORBIACEAE
Monotaxis grandiflora
Stachystemon vermicularis

RHAMNACEAE
Stenanthemum humile

POLYGALACEAE
Comesperma calymega
Comesperma virgatum

RUTACEAE
Boronia racemosa ssp. *anethifolia*
Eriostemon spicatus

APIACEAE
Actinotus glomeratus
Xanthosia candida
Xanthosia huegelii

CHLOANTHACEAE
Pityrodia bartlingii

LAMIACEAE
Hemiandra pungens var. *pungens*
Hemiandra pungens var. *linearis*

GOODENIACEAE
Dampiera linearis
Goodenia caerulea
Isotoma hypercrateriformis
Scaevola paludosa

STYLIDIACEAE
Levenhookia dubia
Stylidium brunonianum
Stylidium carnosum
Stylidium diuroides
Stylidium pubigerum Sonder
Stylidium repens R. Br.
Stylidium schoenoides DC.

XANTHORRHOEACEAE
‡ *Xanthorrhoea drummondii*
‡ *Xanthorrhoea preissii*

ANTHERICACEAE
Arnocrinum preissii
Caesia parviflora
Chamaescilla corymbosa
Johnsonia pubescens
Laxmannia ramosa
Laxmannia squarrosa

‡ *Sowerbaea laxiflora*
Thysanotus manglesianus
Thysanotus sparteus
Thysanotus triandrus
Tricoryne elatior
‡ *Tricoryne tenella*

DASYPOGONACEAE
Calectasia cyanea
Dasypogon bromeliifolius
Dasypogon obliquifolius
‡ *Kingia australis*
Lomandra caespitosa
Lomandra hermaphrodita
Lomandra nigricans
Lomandra preissii
Lomandra sericea

COLCHICACEAE
Burchardia umbellata

IRIDACEAE
Patersonia juncea
Patersonia occidentalis

ORCHIDACEAE
Caladenia discoidea
Caladenia flava
‡ *Caladenia gemmata*
Caladenia latifolia
Leporella fimbriata
‡ *Lyperanthus nigricans*
Microtis alba
‡ *Prasophyllum* sp.
Pterostylis recurva
Pterostylis vittata
‡ *Pterostylis vittata* (brown form)
Thelymitra crinita
Thelymitra nuda

HAEMODORACEAE
Anigozanthos humilis
Anigozanthos manglesii
Conostylis aculeata
Conostylis aurea
Conostylis juncea
Haemodorum laxum
‡ *Haemodorum loratum*
Haemodorum paniculatum
Haemodorum spicatum
‡ *Phlebocarya filifolia*

CYPERACEAE
Caustis dioica
‡ *Cyathochaeta clandestina*
‡ *Lepidosperma tenue*
Mesomelaena pseudostygia
Mesomelaena tetragona
Schoenus curvifolius
Schoenus latitans
Tetraria octandra
Tricostularia neesii

RESTIONACEAE
Alexgeorgea nitens
Hypolaena exsulca
Leptocarpus aristatus
Loxocarya fasciculata
Lyginia barbata

POACEAE
Danthonia caespitosa
Neurachne alopecuroidea
‡ *Stipa* "CARDUP" (G. Keighery)
Stipa elegantissima
‡ *Stipa pycnostachya*

HERPETOFAUNA OF AN URBAN AREA NEAR PERTH, WESTERN AUSTRALIA

By BRAD MARYAN, 169 Egina Street, Mt. Hawthorn 6016

ABSTRACT

The study area is located in the south of the City of Canning between the Perth city centre and the outer suburb of Armadale. Notes are included on the local distribution, relative abundance and habitat preferences for the 33 reptiles and 9 frogs recorded. The frog *Crinia georgiana* and legless lizard *Aprasia pulchella* are infrequently recorded from the coastal plain in this region. The gecko *Crenadactylus ocellatus* may have been inadvertently transported into the area.

INTRODUCTION

Most published data on the herpetofauna of the Perth region are from studies done north of the Swan River (Storr *et al.* 1978; How and Dell, 1990) or the Darling Range (Wellington and Dell, 1989). Little has been published from areas to the south. Turpin (1990 and 1991) demonstrated the importance of suburban remnant bushland in conserving a rich diversity of herpetofauna in an area surrounded by considerable degradation through urban and industrial development. My study reports on the reptile and amphibian fauna in some of the southern suburbs and outlines the effects of urbanisation.

DESCRIPTION OF STUDY AREA

The study area is located approximately 13 kilometres south of Perth and is bounded in the north by the Canning River, in the east by Nicholson Road, in the west by Rossmoyne and in the south by Canning Vale (see Figure 1). For the purpose of this study the area was divided into 2 zones. The Southern Zone comprised the suburb of Canning Vale and the Suburban Zone comprised the 6 suburbs of Ferndale, Lynwood, Riverton, Rossmoyne, Shelley and Willetton.

According to Seddon (1972) the study area lies within 2 landform units, these are the Pinjarra Plain which consists generally of unconsolidated fluviatile sediments and the Bassendean Dune System that represents a Pleistocene accumulation of beach sands along an old coastline. This dune system occupies most of the study area and is the main stronghold for *Banksia* spp. Seddon also recognised 16 soil associations on the Swan Coastal Plain. Three of these are within the study area:

A. The Canning River lies within the Swan soil association and consists of red podsolic and undifferentiated alluvial soils along the present river course.

B. The western boundary of the Southern Zone enters the Bassendean soil association which consists of grey and yellow sand dunes with sandy swamps in the low-lying areas.

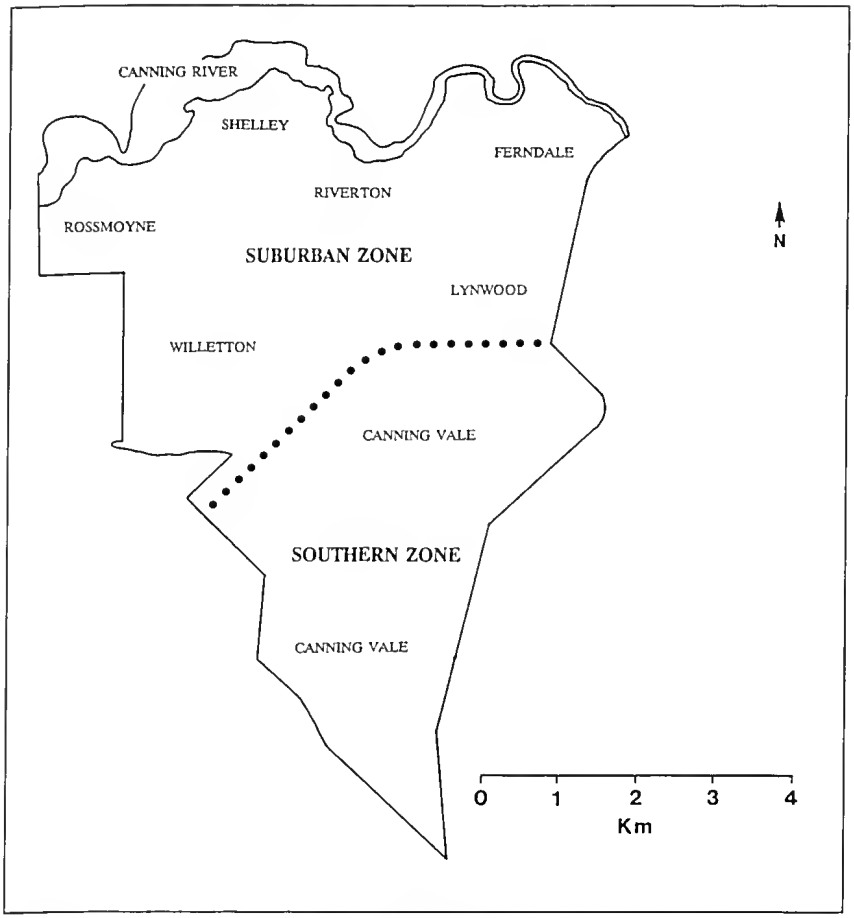

Figure 1. Map showing areas mentioned in text.

C. The area east of the Bassendean soil association and Suburban Zone consists generally of grey sand dunes with intervening clayey swamps. These soils are termed the Southern River association.

Suburban Zone

All observations in this zone were recorded from the remnant pockets of bushland and creek/swamp systems that occur in the 6 suburbs mentioned previously. These habitats have been considerably degraded and retain only scattered patches of trees: *Eucalyptus marginata*, *E. calophylla* and Banksia spp. The disturbance has allowed the introduced veldt grass *Ehrharta calycina* to become well established. In this zone there are some swampy creeks that flow through the suburbs although the vegetation along these has been greatly reduced also. The dominant surviving vegetation is a fringe of *Melaleuca rhaphiophylla*. The vegetation associated with the Canning River is characteristic of a freshwater environment in the Perth

region. Dominating along the river edge is M. *rhaphiophylla*, *Typha orientalis* and *Casuarina obesa*. Away from the river on the flood plain is *Eucalyptus rudis* woodland, *Polypogon monspeliensis* and *Juncus kraussii*. The samphire species *Sarcocornia quinqueflora* and *Halosarcia halocnemoides* are the dominants along the river in the salt-marsh areas.

Southern Zone

The main communities characteristic of the Bassendean soil association are open woodlands consisting of *E. marginata* and *E. calophylla* over a small tree storey of *Banksia* spp. A tall shrubland is most prevalent where *B. attenuata*, *B. grandis*, *B. ilicifolia* and *B. menziesii* occur in varying degrees of density over a mixed low understorey. *Allocasuarina fraseriana* is common here also. In the low-lying areas that are subject to seasonal flooding *Melaleuca preissiana*, *Nuytsia floribunda* and *Xanthorrhoea* sp. are dominant. Dominant species in the tall shrub layer are *Jacksonia furcellata*, *Adenanthos sericea*, *Kunzea ericifolia* and *Macrozamia reidlei*. The low shrub layer is variable with some common representatives being *Hypocalymma angustifolium*, *Acacia pulchella* and *Verticordia* spp. Crook and Evans (1981) provide a detailed account of the representation of the Bassendean soil and vegetation complex on the Thomsons Lake Nature Reserve to the south-west of the present study area.

METHODS

The methods used to locate and observe the reptiles and amphibians included raking through leaflitter and other surface debris; turning over by hand rocks, logs, sheet iron etc; pit-trapping both with and without drift fences; spotlighting from vehicle on warm nights; and opportunistically encountering active animals. No headtorching for nocturnal species was carried out.

Opportunistic observations were made between 1977 and 1987 to determine the herpetofauna occurring within this urban area. Figure 2 shows the relative abundance (frequency of observation) between species of reptiles located during this 10 year study.

LEPTODACTYLIDAE (Ground Frogs)

Crinia georgiana (Quacking Frog)
Only found in low-lying wetlands in southern zone.

Heleioporus eyrei (Moaning Frog)
Very common throughout the area in close proximity to swamps and low-lying places. Often excavated from burrows beneath logs and rubbish during winter.

Limnodynastes dorsalis (Banjo Frog)
Very common in southern zone. Only recorded from near swamp/creek systems in suburban zone. Abundant beneath rubbish during winter.

Myobatrachus gouldii (Turtle Frog)
Three records: 1977 in dark coarse soil at Lynwood; and 2 adults on different days in August 1986 at Canning Vale - one was excavated from a bulldozer soil heap in Banksia woodland and the other was excavated from soil beneath fallen bark.

Pseudophryne guentheri (Guenther's Toadlet)
Very common in low-lying wetlands in southern zone and generally found beneath logs and rubbish in suburban zone.

Ranidella glauerti
Heard calling from a number of ephemeral swamps and gullies in southern zone and also from a permanently watered creek in Lynwood.

Ranidella insignifera
Found throughout the area in low-lying wetlands, swamp/creek systems and along the Canning River.

HYLIDAE (Tree Frogs)

Litoria adelaidensis (Slender Tree Frog)
Very common in *Typha* vegetation along the Canning River. Only found in low-lying wetlands in southern zone.

Litoria moorei (Western Green Tree Frog)
Very common throughout the entire are wherever any body of water occurs including backyard swimming pools.

CHELUIDAE (Freshwater Turtles)

Chelodina oblonga (Oblong Turtle)
Found in the Canning River and major swamps in the area. During this 10 year observation period a large population existed in a Water Authority treatment plant on an oval in Lynwood.

GEKKONIDAE (Gecko Lizards)

Crenadactylus ocellatus (Clawless Gecko)
A single animal found beneath a wooden boat in a suburban backyard at Lynwood in 1981.

Phyllodactylus marmoratus (Marbled Gecko)
Most specimens were found active at night on roads while spotlighting in *Banksia* woodland at southern zone, the very few sightings from the suburban zone include an animal taken from inside a letterbox on 2 October 1981 at Lynwood.

PYGOPODIDAE (Legless Lizards)

Aprasia pulchella
One beneath a sheet of iron on soil at Riverton on 4 October 1980 and another nearby on the following day.

Aprasia repens
Mainly found in soil beneath logs and rubbish, inside soil heaps (particularly on the edge of tracks) in the southern zone.

Delma fraseri (Fraser's Legless Lizard)
In *Banksia* woodlands in the southern zone and in the Willetton area beneath rubbish, inside spoil heaps and inside dead Xanthorrhoea.

Delma grayii

Only recorded in southern zone where it mainly shelters inside dead *Xanthorrhoea* and beneath rubbish. Appears to prefer low-lying areas where *Xanthorrhoea* is dominant.

Lialis burtonis (Burton's Legless Lizard)
Found throughout the area. Observed active both day and night and collected beneath rubbish, logs and piles of decaying vegetation.

Pletholax gracilis
Adult pit-trapped among low shrubbery in *Banksia* woodland on deep white sand on 22 December 1984 at Willetton.

Pygopus lepidopodus (Common Scalyfoot)
Found in *Banksia* woodland in the southern zone and Willetton. Mostly located active on roads at night.

AGAMIDAE (Dragon Lizards)

Pogona minor (Bearded Dragon)
Found throughout the area. Mainly observed basking on living and dead *Banksia* trees and *Xanthorrhoea*, occasionally found beneath rubbish.

Tympanocryptis adelaidensis
Four adults pit-trapped among low shrubbery in *Banksia* woodland at Willetton between 16-22 December 1984.

SCINCIDAE (Skink Lizards)

Bassiana trilineatum (Swamp Skink)
Very common throughout the area, particularly beneath rubbish near swamps and the Canning River as well as active in peripheral vegetation.

Cryptoblepharus plagiocephalus (Wall Skink)
Very common throughout the area on a wide variety of trees and shrubs. Also frequently seen on wooden, brick and cement-sheet fences and houses.

Ctenotus fallens
Appeared to prefer the low-lying more damper areas such as the fringing flooded gum woodland near the Canning River at Ferndale. Most often found beneath rubbish.

Ctenotus impar
Found in the southern zone beneath rubbish, inside spoil heaps and observed active in *Banksia* woodland.

Ctenotus lesueurii
Only recorded in southern zone where it was observed active in *Banksia* woodland and also found beneath rubbish.

Egernia napoleonis (Napoleon's Skink)
Only recorded in southern zone where it shelters in dead *Xanthorrhoea* and sometimes beneath bark on dead *Banksia* trees.

Hemiergis quadrilineata (Yellow-bellied Skink)
Frequently found beneath leaflitter and other surface debris in backyards in Rossmoyne and Wilson near Canning River, elsewhere found beneath logs in southern zone where less numerous.

Lerista elegans
Mostly found in soil beneath logs and sheet iron in the southern zone.

Lerista lineata
Two records from the southern zone: four animals in loose soil beneath sheet iron and clay tiles on 18 August 1984; and one from soil beneath abandoned stick-ant nest in *Banksia* woodland on 10 October 1987.

Menetia greyii (Grey's Skink)
Very common throughout the area especially where rubbish provides shelter. Most abundant reptile in study area (see Figure 2).

Morethia obscura
Four adults observed active among low shrubbery in *Banksia* woodland at Willetton on 30 August 1984.

Tiliqua occipitalis (Western Bluetongue)
An adult found beneath car door in *Eucalyptus/Banksia* woodland in southern zone on 10 October 1987.

Tiliqua rugosa (Bobtail)
Found throghout the area. Mostly encountered beneath sheet iron and other rubbish or seen active in southern zone.

VARANIDAE (Monitor Lizards)

Varanus gouldii (Gould's Monitor)
Mainly found beneath sheet iron (particularly car bonnets), inside dead logs after being observed nearby and seen active in southern zone.

TYPHLOPIDAE (Blind Snakes)

Ramphotyphlops australis
One record from suburban zone and two from southern zone: an animal inside a bulldozer spoil heap at Lynwood in 1979; one on 15 August 1981 beneath iron in grassland and one beneath fragmented cement slab on 10 March 1986.

Ramphotyphlops waitii
An aggregation of 10 sub-adults beneath a rock in a suburban yard at Shelley in 1979.

ELAPIDAE (Front-fanged Land Snakes)

Notechis coronatus (Crowned Snake)
Three records from southern zone: a juvenile inside dead *Xanthorrhoea* on 16 July 1983; an adult active in low grass on 12 October 1985; and two beneath sheet iron in high grass on edge of bitumen road on 11 September 1986.

Notechis scutatus (Tiger Snake)
Found in peripheral vegetation along the Canning River and near major swamps, also beneath sheet iron and other rubbish near these.

Pseudonaja affinis (Dugite)
Frequently encountered in southern zone around farmlets. Always abundant during the warmer months where sheet iron and other rubbish is strewn around providing shelter both for this snake and its preferred food the house mouse.

Rhinoplocephalus gouldii (Gould's Snake)
Only recorded in southern zone where it sheltered inside dead *Xanthorrhoea* and beneath rubbish.

Vermicella bimaculata (Black-naped Snake)
Adult excavated from spoil heap in burnt *Banksia* woodland in southern zone on 3 February 1986.

DISCUSSION

Due to the size of the area concerned, the 33 reptiles and 9 frogs recorded here exceeds the 29 reptiles and 3 frogs recorded near Perth in Bold Park Reserve by How and Dell (1990). However, wih increased pressure from ongoing development, a similar survey to this carried out in several years time may find the species number has reduced.

Literature searches in the Western Australian Museum reveal that a further 10 species have been recorded near the study area on the coastal plain. They are *Diplodactylus polyophthalmus* (Kelmscott), *Diplodactylus spinigerus* (Forrestfield), *Egernia kingii* (Armadale), *Varanus tristis* (Gosnells), *Morelia spilota* (Gosnells), *Acanthophis antarcticus* (Kelmscott), *Demansia psammophis* (Cannington), *Vermicella bertholdi* (Armadale), *Vermicella calonotos* (Bateman) and *Vermicella semifasciata* (Gosnells). To the north of this area (Victoria Park) Turpin (1990) recorded the first *Diplodactylus alboguttatus* south of the Swan River. A lack of headtorching in my study may account for the low number of geckos and other nocturnal species.

The only possible addition is *Heleioporus psammophilus* which is similar to *H. eyrei* but differs in call and colouration. ICrinia georgiana is infrequently recorded from the coastal plain being much more common on the more timbered Darling Range (Tyler *et al.*, 1984). Storr and Harold (1978) recorded this species from the valleys and floodplains in the eastern zone of the northern Swan Coastal Plain.

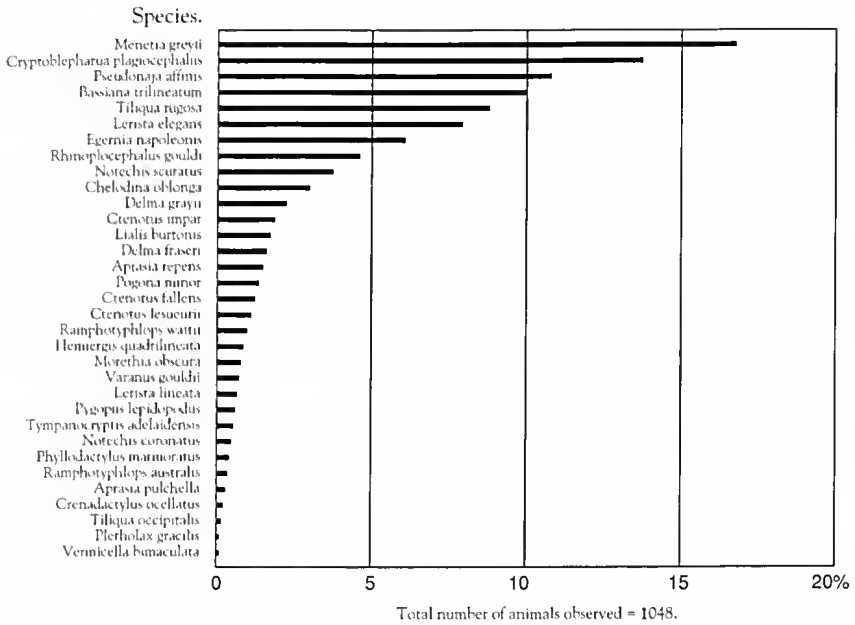

Figure 2. Relative abundance of reptiles over a 10 year period in the study area.

The gecko *Crenadactylus ocellatus* is locally common in the Darling Range, however on the coastal plain it is restricted to the Tuart belt.It is highly probable that the one found in the study area was inadvertently transported here as no other specimens were recorded and it was located in a suburban backyard. For other examples of the inadvertent movement of reptiles see Bush (1987). The few observations of geckos as demonstrated in Figure 2. is probably due to the lack of headtorching carried out for nocturnal species. The apparent scarcity of *Phyllodactylus marmoratus* in the study area is interesting considering its successful adaptation to suburban environments elsewhere. The abundance of this gecko may be in direct relation to the age of a suburb and the amount of trees that have been felled to allow for development. In the Perth Metropolitan Area they do appear to be more prevalent in the older-style suburbs. Legless lizards are well represented in the study area by 7 species. The most notable of these is *Aprasia pulchella* which is common on the Darling Range. On the coastal plain it appears to favour the clay substate found in the vicinity of the Swan River close to the foothills.

The skink lizards are the most diverse and abundant reptiles in the study area accounting for the majority of observations (number - 720, Figure 2). The species *Cryptoblepharus plagiocephalus* and *Menetia greyii* both have almost Australia wide distributions and were the two most abundant skinks recorded. However, one species *Lerista lineata* has a very small known distribution from Mandurah north to the southern suburbs of Perth. Most of the natural habitat within its range has been lost or degraded due to urban and industrial development and, as progress continues, its numbers must correspondingly decrease. It does however appear to be common Garden and Rottnest Island and in nature reserves on the mainland including Forrestdale Lake and Modong.

All the reptiles listed are within their known range and most are widely distributed throughout the south-west. The small snake *Notechis coronatus* is close to the norhern end of its range in the metropolitan area, only extending north of Perth to Muchea. I have also recorded this snake just south of the study area at Forrestdale Lake Nature Reserve. The record of *Ramphotyphlops waitii* is a significant Coastal Plain record as this species is mainly found further inland on heavy soils.

The study area encompasses two extremes of major habitat for the herpetofauna in the Perth region. The Suburban Zone with almost a complete loss of the natural habitat through urban development and the Southern Zone which mostly consists of undisturbed *Banksia* woodlands with some industrial development to the north and scattered farmlets and cleared paddocks through it. The 3 species *Delma grayii, Egernia napoleonis* and *Rhinoplocephalus gouldii* were only found in the Southern Zone where *Xanthorrhoea* is present. Excluding this habitat association all but 2 species were recorded in both zones. To sustain species diversity in areas

undergoing massive development this illustrates the importance of even the smallest pocket of natural habitat.

Modifications to the environment through development can benefit some species. Clearing for farmlets creates or enlarges a grasslands habitat. The most common snake recorded in the study area was the Dugite, *Pseudonaja affinis* with 112 separate observations. This snake's cycle of abundance appears strongly influenced by the presence or not of semi-cleared bushland where there is plenty of introduced mammals for food and adequate shelter. Of course, once the development moves to the stage whereby the grasslands are themselves lost this species will become locally extinct.

ACKNOWLEDGEMENTS

I thank Mr Brian Bush for assisting me in the preparation of this paper and Mr Leon Harris for assisting with vegetation notes on the study area. The map is courtesy of the City of Canning.

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First Record of a Herald Petrel *Pterodroma arminjoniana* in Western Australia. - On 31 May 1992 one of us (T.K.) observed a strange gadfly-petrel over Varanus Island, Lowendal Islands, Western Australia. The bird was circling part of the island during the day, calling continuously (high pitched short screeches) and chasing other birds that entered the area

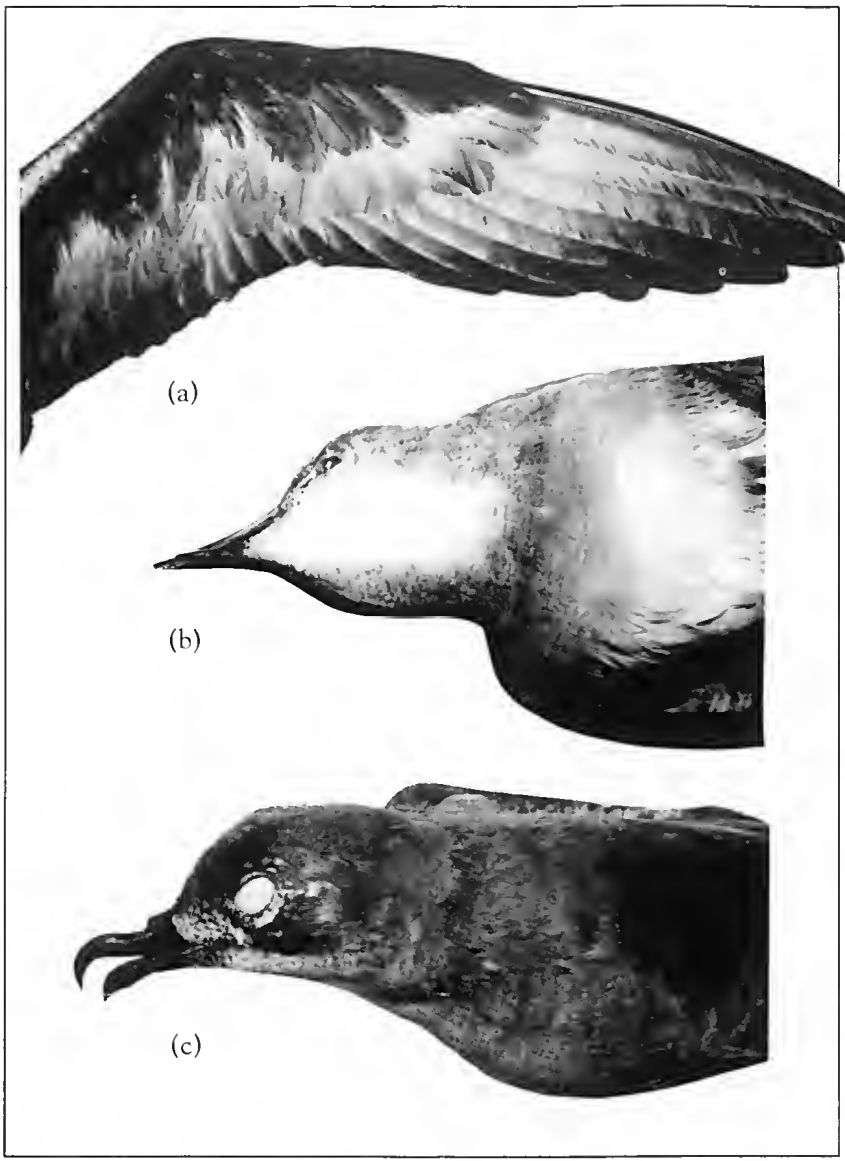

Figure 1. Herald Petrel showing (a) underwing pattern, (b) breast band and (c) facial pattern.

including Crested Tern, Kestrel, Brahminy Kite and Osprey. The following day the bird was killed when it flew into the blades of a helicopter. The remains were collected and donated to the Western Australia Museum where it was prepared into a study skin (registered number A 24536) and identified as a Herald Petrel *Pterodroma arminjoniana* (Giglioli and Salvadori).

Details of the the specimen are as follows: adult female with ovary 16 x 8 mm; total length 328 mm; exposed culmen 27.0 mm, entire culmen 38.0 mm; culmen width 13.7 mm; wing 278 mm; tail 101 mm; tarsus 32 mm; middle toe and claw 46 mm; forehead dark greyish brown the feathers narrowly edged whitish giving a scalloped appearance; lores mostly white flecked with greyish brown; a few white flecks over eye; crown, nape and back dark greyish brown (the feathers with concealed white bases and some short white filoplumes on nape); sides of neck grading to greyish brown; wings, rump and the few remaining tail feathers blackish brown, the inner webs of primaries grading to white; indistinct blackish line from gape to below eye; chin and centre of throat white; sides of throat and broad breast band grey (see Figure 1); belly white; flanks grey or brownish grey, most feathers with concealed white bases; axillaries dark greyish brown; marginal underwing coverts (from armpit almost to shoulder) white, rest dark greyish brown or blackish brown; lesser and median converts mostly grey or blackish brown; greater secondary coverts grey grading to white basally; greater primary coverts white with broad grey tip; primaries blackish on outer web and tip, basal two-thirds of inner web white (forming a broad white patch on outer wing (see Figure 1); secondaries and tertiaries mostly grey with concealed white bases; undertail coverts white basally, grey distally; bill black; legs and feet pink with distal two-thirds of toes and webs blackish.

The Herald Petrel breeds on islands in the south Atlantic Ocean (Trinidade and Martin Voz Rocks) and in the southern Indian Ocean (Round Island off Mauritius) and also on islands in the tropical Pacific (including Raine and islands as far east as Easter Island) [*Peters (1979) Checklist of birds of the World* 1 p. 71]. In Australian waters it is recorded breeding in small numbers on Raine Island and four pairs were suspected breeding on North Keeling Island in 1986 (Stokes, T., and P. Goh 1987. *Aust. Bird Watcher* 12: 132-2).

The Western Australian specimen matches well with photographs taken of a light morph bird on North Keeling in 1986. Based on the possible breeding on North Keeling Island and the territorial behaviour of the Western Australian bird it would appear that this species may be expanding its range into the tropical eastern Indian Ocean.

- R.E. JOHNSTONE, W.A. Museum Perth and T. KIRKBY, 14 Fourth Road, Armadale, W.A.

Short-nosed Bandicoot *Isoodon obesulus* on Culeenup Island - On visits to Yunderup Nature Observatory (YNO), Culeenup Island, Murray River delta (21-3-92, 16-5-92, 31-5-92), observations were made on the Short-nosed Bandicoot *Isoodon obesulus*. These included two sightings, the first on a walk track between the YNO and the large ephemeral lake en route to Cooper's

Mill at 10.00 hrs. The bandicoot was observed scurrying across the track between areas of *Watsonia bulbillifera*. The second was that evening from the balcony of the YNO and was witnessed by several people. This time a bandicoot was observed foraging under trees. Several other observations indicate the presence of the animal on Culeenup Island, these include: (i) numerous diggings (characterised by shallow, narrow, conical holes often with an indent in the base made by the nose); (ii) unusual shaped scats next to the diggings (not identified as belonging to rabbit, kangaroo, fox or cat which occur on the island); (iii) recent skeletal remains, including part of the skull which was identified by the W.A. Museum (A. Baynes, pers. comm.). Diggings and scats were also observed on Jeegarnyeejip Island (opposite the YNO) where the bandicoot has not been recorded before.

This is not the first time that bandicoots have been found in the delta as in 1987, an individual was accidentally caught in a pit-fall trap during a reptile survey of Culeenup Island. However, the numerous recent observations suggest that there are several populations currently thriving on the islands of the delta. :The isolation of the islands may provide an important refuge for this species.

- MELVYN J. LINTERN and SUZIE P. ROE, 24 Fairfield Street, Mt. Hawthorn, W.A. 6016.

First records of two reptiles *Morelia spilota imbricata* (Boidae) and *Tiliqua occipitalis* (Scincidae) from the vicinity of Eyre Bird Observatory, Western Australia - During a visit by P.G. to the Eyre Bird Observatory in November 1991, T.H. related to P.G. the details of a sighting of *Morelia spilota imbricata* in open woodland at the base of the escarpment *ca* 10 km N of Eyre on 25 October 1991. The snake which was ca 1.3 metres in length, was at the edge of the road at *ca* 0800hr and moved away very slowly when disturbed. T.H. saw the snake with Greg Osborne who photographed it. A copy of a photograph taken by Greg Osborne has been lodged at the Western Australian Museum.

Storr, G.M., Hanlon, T.M.S. and Harold, G. (1981 Herpetofauna of the shores and hinterland of the Great Australian Bight, Western Australia. *Rec. West. Aust. Mus.* 9: 23-39) do not record this or any other members of the family Boidae from their region.

On 21 November 1991, P.G. found an adult *Tiliqua occipitalis* under corrugated iron at "nine mile hut" ca 14 km W of Eyre Bird Observatory.

Storr *et al.* (*supra cit.*) record this skink only from the "extreme southwest" of their region (Israelite Bay and 8 km W).

Both of these observations are new to the Eyre region and represent range extensions of 350 km E and 270 km ENE for the snake and skink respectively.

P. Congreve (1985 Reptiles recorded from the vicinity of Eyre Bird Observatory, *Eyre Bird Observatory Report* 1981 - 1983; 3: 125-128) mentions two other taxa which were collected after the publication of Storr *et al.* (*supra cit.*): namely *Ctenotus uber uber* (Scincidae) and *Chelonia mydas* (Cheloniidae).

These records bring the perpetofauna of the region covered by Storr *et al.* to 11 families, 37 genera and 74 species and subspecies.

-PHILLIP GRIFFIN c/o 3 Evershed Street, Myaree 6154 Western Australia and TIM HUNT c/o Eyre Bird Observatory c/o Cocklebiddy vie Norseman 6443 Western Australia.

First Record of a Gould's Petrel *Pterodroma leucoptera* (Gould) in Western Australia - On 10 December 1990 Mr and Mrs G. Goodreid, Wardens of the Eyre Bird Observatory, found a small dead and partly eaten petrel near Eyre, Western Australia. The bird was donated to the Western Australian Museum where it was prepared into a mummified specimen (registered number A23837) and identified as *Pterodroma leucoptera*.

Details of the specimen are as follows: total length 290mm; exposed culmen 26.0 mm; entire culmen 36.0 mm; culmen width 8.4 mm; wing 220 mm; tail 99 mm; tarsus 29 mm; middle toe and claw 36 mm; forehead white scalloped with black; crown and nape blackish; base of bill and cheeks white; upper back dark grey to grey; wings mostly blackish, primaries with white wedge at base of inner web, secondaries mostly grey with white inner web; rump blackish grey; central tail feathers mostly dark grey tinged blackish at tip and with white at base on inner web, outer feathers (except outermost) grey with white increasing on inner web, outermost feather with grey outer web and white inner web peppered with grey near tip; ;underparts white except for patch of dark grey on side of breast; underwing white with blackish tips to flight feathers and dark leading edge of wing angling in at carpal joint to form a blackish carpal bar.

In Australian waters Gould's petrel breeds only on Cabbage Tree island off Port Stephens, New South Wales. it is a summer breeder, the birds returning to the island in October, egg laying begins in November and the adults and young leave in March/April (Marchant and Higgins 1990, *Handbook of Australian, New Zealand and Antarctic Birds*). The birds are absent from the breeding site from May to October and their movements away from the breeding ground are largely unknown. Beach washed birds have been found in Victoria, New South Wales and Queensland.

- R.E. JOHNSTONE, Western Australian Museum, Perth.

CLUB NEWS

Programme

General Meetings are held on the first Friday in the month at the Naturalists' Hall, 63-65 Meriwa Street, Nedlands, at 8 p.m.

The Retired and Leisured Group meets on alternate Wednesdays at 10 a.m.

Meetings of the Intermediate and Junior Members are held following the General Meetings and take the form of excursions to places of natural history interest.

Excursions and field days for Senior, Intermediate and Junior Members are planned from time to time and will be advertised in the Club's monthly newsletter "The Naturalist News".

THE WESTERN AUSTRALIAN NATURALIST

(Journal of the W.A. Naturalists' Club)

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The Western Australian Naturalist, publishes original data on all branches of natural science pertaining to Western Australia. Originals and two copies of manuscripts should be submitted to the Editor for review by referees. Authors are requested to follow current editorial style.

DONATIONS TO THE CLUB

Members are reminded that they may make financial contributions to the Club through three main funds. Only one of these is associated with tax deductibility privileges at present — the Library Fund, for additions to Naturalists' Hall. The General Purposes Fund, under present taxation laws, is unlikely to receive tax deductibility privileges but it is a very important fund from the Club's point of view, as it helps our publication activities, hall maintenance and other miscellaneous activities. Members are asked to remember the Club and its needs when preparing their Wills and Testaments.

SUBSCRIPTIONS

Annual Membership: Senior, $36.00; Double Membership: $44.00; Family Membership: $47.00; Nomination Fee (Seniors only): $5.00; Preceding Subscriptions include "The Western Australian Naturalist". Intermediates (aged 14 to 17 years): $21.00; Juniors (aged 9 to 13 years): $21.00.

Further copies of the "Western Australian Naturalist" (or back copies) are available from the Treasurer.

HANDBOOKS

The Club's Handbooks are for sale

No. 2	Natural History Specimens: their Collection and Preservation. 5th edition. Price $4.00
No. 7	The Dragonflies (Odonata) of South-Western Australia. By J.A.L. Watson. Price $3.50.
No. 10	A Guide to the Coastal Flora of South-Western Australia. By G.G. Smith (2nd Ed.). Price $9.00.
No. 11	The Natural History of the Wongan Hills. K.F. Kenneally (Co-ordinator). Price $6.00.
No. 12	Mangroves of Western Australia. By V. Semeniuk, K.F. Kenneally and P.G. Wilson. Price $6.00.
No. 13	A naturalists' guide to Perth. By B.M.J. Hussey, M. Southwell-Keely and J.M. Start. Edited by Kevin Kenneally. Price $10.95.
No. 14	Checklist of the vascular plants of the Kimberley, Western Australia. By Kevin Kenneally. Price $10.00.

* Prices shown do not include postage and packing. *